TECHNICAL MANUAL

OPERATION AND SERVICE INSTRUCTIONS

DEPOT

ENGINE TEST

AIRCRAFT ENGINE
USAF MODEL
F100-PW-229

PRATT & WHITNEY
LARGE MILITARY ENGINES
UNITED TECHNOLOGIES CORPORATION
F33657-84-C-2014
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THIS PUBLICATION IS ONE OF A SET OF TWELVE MANUALS. THE COMPLETE SET CONSISTING OF T.O. 2J-F100-53-1 THROUGH T.O. 2J-F100-53-11 AND T.O. 2J-F100-11-2 IS REQUIRED FOR DEPOT MAINTENANCE.

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RECORD OF CHANGES

Change	Date	Change	Date
Original	15 Aug 91	Change 15	15 Aug 95
Change 1	15 Nov 91	Change 16	15 Nov 95
Change 2	15 Feb 92	Change 17	15 Feb 96
Change 3	15 May 92	Change 18	15 May 96
Change 4	15 Aug 92	Change 19	15 Aug 96
Change 5	15 Nov 92	Change 20	15 Feb 97
Change 6	15 Feb 93	Change 21	15 May 97
Change 7	15 May 93	Change 22	15 Aug 97
Change 8	15 Aug 93	Change 23	15 Nov 97
Change 9	15 Nov 93	Change 24	15 Feb 98
Change 10	15 Feb 94	Change 25	15 Aug 98
Change 11	15 May 94	Change 26	15 Nov 98
Change 12	15 Aug 94	Change 27	15 Feb 99
Change 13	15 Nov 94	Change 28	15 May 99
Change 14	15 May 95	Change 29	15 Aug 99

TOTAL NUMBER OF PAGES IN THIS MANUAL IS 1738

LIST OF EFFECTIVE FRONT MATTER PAGES

NUMERICAL INDEX OF EFFECTIVE WORK PACKAGES

NOTE

Only those work packages and subordinate work packages assigned to this manual are listed in this index.

Insert Change 29 work packages and subordinate work packages, dated 15 August 1999. Dispose of superseded work packages and subordinate work packages. If changed pages are issued to a work package or subordinate work package, insert the changed pages in the applicable work package or subordinate work package. The portion of the text affected in a changed WP or SWP is indicated by change bars in the outer margin of each column of text. Changes to illustrations are indicated by pointing hands or change bars, as applicable. Changes to wiring diagrams are indicated by shaded areas.

NUMERICAL INDEX OF EFFECTIVE WORK PACKAGES (continued)

WP/SWP Number	*CHANGE NO.
005 00	7
006 00	24
007 00 through 099 00	Open
100 00	0
101 00	0
102 00	0
103 00 through 107 00	Open
108 00	0
109 00	24
110 00	0
111 00 through 199 00	Open
200 00	27
201 00 through 203 00	Open
204 00	0
205 00	29
206 00	26
207 00	0
208 00	0
209 00	28
210 00	22
211 00	26
212 00	29
213 00	23
214 00	0
215 00	27
216 00	0
217 00	0
218 00	8
219 00 through 224 00	Open
225 00	4
226 00	0
227 00 through 299 00	Open
300 00	24
301 00	24
302 00	2
303 00	0
304 00	24
305 00	0
306 00	19
307 00	0
308 00 New	24
309 00 through 399 00	Open
400 00	0
401 00	10
402 00	5
403 00 through 499 00	Open
500 00	28
501 00	28
502 00 through 503 00	Open
504 00	0
505 00	0
506 00	0
507 00	0
508 00	0
509 00	5
510 00	0
511 00	0
512 00	0
513 00	0
514 00	21
515 00	0
516 00	0
517 00 Revised	9
518 00	0
519 00	0
520 00	0
521 00	0
522 00	0
523 00	27
524 00	0
525 00	0
526 00	0
527 00	0
528 00 New	18
529 00	27
530 00	12
531 00	0
532 00	24
533 00	25
534 00	0
535 00	0
536 00	28
537 00	0
538 00	0
539 00	0
540 00	0
541 00	0
542 00	0

NUMERICAL INDEX OF EFFECTIVE WORK PACKAGES (continued)

WP/SWP Number	*CHANGE NO.
543 00	0
544 00	0
544 01 New	21
545 00	23
546 00	0
547 00 New	21
548 00 New	21
549 00 New	23
550 00	0
551 00	Open
552 00	23
553 00	0
554 00	18
555 00	22
556 00	22
557 00	0
558 00	0
559 00	0
560 00 through 561 00	Open
562 00	22
563 00 through 564 00	Open
565 00	23
566 00 New	23
567 00	18
568 00	0
569 00	0
570 00	0
571 00 through 574 00	Open
575 00	28
576 00 Deleted	23
577 00	Open
578 00	24
579 00	Open
580 00	0
581 00 through 589 00	Open
590 00	0
591 00 through 599 00	Open
600 00	25
601 00	18
602 00	2
603 00	0
604 00	0
605 00	3
606 00	4

WP/SWP Number	*CHANGE NO.
607 00	21
607 01 New	23
608 00	0
609 00	0
610 00	0
611 00	0
612 00	11
613 00	6
614 00	0
615 00	0
616 00	0
617 00	Open
618 00	28
619 00	14
620 00	18
621 00	28
622 00	0
623 00	0
624 00	0
625 00	18
626 00	28
627 00	0
627 01	27
628 00	18
629 00	0
630 00	0
631 00	18
632 00	18
633 00 through 635 00	Open
636 00	0
637 00	18
638 00	18
639 00 through 644 00	Open
645 00	28
646 00	24
647 00	0
648 00	0
649 00	18
649 01	18
650 00	0
651 00	12
651 01 New	20
652 00	0
653 00	12

NUMERICAL INDEX OF EFFECTIVE WORK PACKAGES (continued)

WP/SWP Number	*CHANGE NO.
654 00	0
655 00	12
656 00	29
657 00	12
658 00	12
659 00	12
660 00	0
661 00	0
662 00 Revised	6
663 00	0
664 00	20
665 00	0
666 00	Open
667 00	17
668 00 through 669 00	Open
670 00	0
671 00 through 674 00	Open
675 00	29

*Zero in this column indicates original WP/SWP.

All data on pages VS-1 and VS-2 deleted.

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

This is a list of TCTO’s applicable to this manual. TCTO’s will also be listed in the work packages to which they apply.

T.O. No.	Date	Level	Title (ECP No.)
T.O. 2J-F100229-518	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-15 Aircraft (ECP 92QA093)
T.O. 2J-F100229-519	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-16 Aircraft (ECP 92QA093)
T.O. 2J-F100229-524	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-15 Aircraft (ECP 92QA141)
T.O. 2J-F100229-525	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-16 Aircraft (ECP 92QA141)
T.O. 5E1-2-15-507	15 Jun 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)
T.O. 6J3-4-117-513	8 Mar 94	O/I	Upgrade of Digital Electronic Control (DEEC) PN 796521H04D04 to 2.6.2A Logic, F100-PW-229 Engine, F-15 Aircraft (ECP 93QA389)

SAFETY SUMMARY

INTRODUCTION

This technical order (T.O.) describes physical and chemical processes which may require the use of chemicals, solvents, paints, or other commercially available hazardous material. This T.O. also describes maintenance actions which may require handling or use of potentially dangerous parts or equipment.

Personnel performing maintenance procedures and practices included in this T.O. shall be familiar with safety precautions and procedures associated with chemicals and other hazardous materials, parts and equipment. The user of this T.O. shall consult their local safety and health staff and Material Safety Data Sheet (MSDS) concerning any questions on hazardous chemicals, personal protective equipment requirements, and appropriate handling and emergency procedures. The user shall become completely familiar with the manufacturer/supplier information and adhere to the procedures, recommendations, warnings, and cautions of the manufacturer/supplier for the safe use, handling, storage, and disposal of these materials. Disregarding safety precautions and procedures or performing unauthorized maintenance can cause engine or equipment damage, serious injury, illness, or death.

WARNING, CAUTION, and NOTE STATEMENTS

WARNING

Highlights an essential operating or maintenance procedure, practice, condition, or statement which, if not strictly observed, could result in personal injury, loss of human life, or an acute/chronic health hazard.

CAUTION

Highlights an essential operating or maintenance procedure, practice, condition, or statement which, if not strictly observed, could result in equipment damage or destruction.

WARNINGS (for personnel protection) or CAUTIONS (for equipment protection) precede selected procedures in this T.O. for additional emphasis. WARNINGS and CAUTIONS are used where emphasis beyond the general safety precautions and instructions are required because the equipment, procedures, or work environment represents an unusual situation (nonroutine use or application) to the technician. The WARNING or CAUTION applies each time the related step is repeated.

NOTES

A note describes an unusual procedure or condition which special attention must be paid for a particular reason.

Notes are not part of safety. A note does not replace a warning or caution.

SAFETY SUMMARY (continued)

BACKUP WRENCH

When torquing or breaking torque on any tube coupling nut, use a suitable wrench to apply torque to the fitting to which the part is attached. Failure to properly use a backup wrench can result in failure of tubes and accessories due to stress loading during torquing procedures.

BEARING HANDLING

The most common cause of bearing damage is attributed to improper preservation and mishandling. Do not handle bearings with bare hands. Wear approved gloves when handling bearings. Coat bearings with engine oil and store in labeled containers as matched sets. Ensure all bearing components have matching serial numbers before installation to prevent bearing failure due to mismatched contact surfaces.

BRAZING, SOLDERING AND WELDING

Brazing, soldering and welding operations may produce fumes that can be harmful to breathe. Arc welding emits ultraviolet light, which can burn the skin and eyes. Provide adequate ventilation. Wear protective clothing/equipment. Ensure gas bottles are properly secured.

CABLES, ELECTRICAL

Small radius bends or severe flexing of electrical cables can result in damage to conductors and/or outer braid.

CARBON SEALS AND SEAL SEATS

Carbon seals and carbon seal seats are easily damaged and shall be handled with care. Do not allow carbon seals to come in contact with petroleum based solvents. These solvents will reduce the lubricity of the carbons and result in rapid seal wear. Do not handle carbon seals or seal seats with bare hands. Wear approved, lint free gloves.

CHEMICAL COMPOUNDS AND SOLUTIONS

Many of the chemical compounds and solutions used in cleaning, inspection, and repair may cause irritation to the skin, eyes, and respiratory system. Many of the chemicals, including their vapors, may be poisonous, easily ignited, corrosive, and react violently with incompatible materials. Improper mixing and combining of these chemicals may produce violent reactions, rapid heat generation, and explosive/toxic gases. Heating certain chemicals may cause toxic gases to be produced. Observe manufacturer’s warning labels and Material Safety Data Sheet (MSDS) instructions for proper handling, storage, and disposal. Consult the local Safety Office for additional information.

COMPRESSED AIR

Compressed air can generate flying debris and can cause severe injury if air blast penetrates the skin or eyes. Reduce compressed air pressure for cleaning or drying to less than 30 psig. Use with effective chip guarding and personal protective equipment. Do not direct air blast toward other personnel.

SAFETY SUMMARY (continued)

COMPRESSED GASES

Many compressed gases are highly flammable/explosive and can cause suffocation at varied levels of concentration or exposure time. Some of the gases can freeze body tissue. Keep ignition sources away. Provide adequate ventilation. Wear protective clothing/equipment. Store in properly marked/labeled containers at approved locations. Do not use in confined areas which may create an explosive atmosphere. Refer to specific Material Safety Data Sheet (MSDS) for additional information.

DANGEROUS PRESSURE

Pressure system precautions apply to all equipment using gases and fluids at all ranges of pressure. To avoid injury, stand clear of tooling and parts being pressure tested when pressure is being applied. Proper tool installation, shielding and hose connections shall be ensured before applying pressure. Ensure all system components are compatible with pressures applied and pressure medium used. Pressure shall be applied slowly.

ELECTROSTATIC DISCHARGE (ESD)

Circuit card assemblies and their related components may be damaged by undetectable electrostatic discharge. Care shall be used during handling or repair of these items. Use electrostatic discharge precautionary standard operating procedures.

ENGINE AND ACCESSORIES - TEMPERATURE

Aircraft engines and accessories are extremely hot following operation. Allow sufficient time to cool or wear protective clothing/equipment when maintenance or inspection tasks are required following engine operation. Failure to comply may result in injury to personnel.

ENGINE AND CONTROLS PRESERVATION

Engines and engine controls shall be drained of all fuel and preserved before shipping. Failure to drain fuel can result in a fire hazard. Engine preservation replaces any fuel with oil, which acts as a corrosion preventing agent.

FOREIGN OBJECT DAMAGE (FOD)

Foreign objects can enter engine compartments and accessories during maintenance. Always be aware of the potential for foreign object damage (FOD) entering any uncovered opening of an engine or accessory. Always thoroughly clean parts and compartments to remove all foreign material. Make a final detail inspection of the work area when the job is finished. Follow standard operating procedures for tool and equipment accountability.

FOOD AND TOBACCO

Wash hands and face thoroughly prior to smoking tobacco products or eating food. Residue of the materials used in engine and equipment maintenance can cause serious health problems if ingested or inhaled in the smoke.

HEARING PROTECTION

The frequency and intensity of noise generated during some operations may cause an acute or chronic hearing impairment. Wear approved hearing protection equipment. Contact the local safety office or bioenvironmental engineering for further guidance.

SAFETY SUMMARY (continued)

HYDRAULIC TOOLING

Application of hydraulic pressure to tooling or engine parts can cause them to jump with enough force to cause personal injury. Excessive pressure applied to tooling by a hydraulic pump can cause a structural failure to the engine part and/or the tooling which could result in personal injury. Using a ram with a nonapproved part number or exceeding hydraulic pump pressure can result in excessive pressure being applied to tooling. Do not exceed ram capacity for a given tool. Stand clear of tooling and engine parts during hydraulic tool operations.

JEWELRY

Remove rings, watches, necklaces, and other metallic objects that may be snagged or cause shock or burn hazards.

LEAD SEALS

Lead seals shall only be removed when specifically called for in the procedure. Lead seals identify areas of critical adjustment that can only be attained at the Depot or Vendor level.

LIFTING, ROTATING, AND SUPPORTING

Personnel shall stay clear of objects being lifted during hoist operations or when objects are supported by temporary transition supports. To prevent personal injury, use adequate number of personnel and appropriately rated lifting/handling devices to lift or move objects. Unless specified in the procedures, personnel shall not work on objects suspended by a hoist or supported by temporary transition supports. Personnel shall be prepared for potential unbalanced conditions during hoist operations.

LIVE ELECTRICAL CIRCUITS

Do not work on electrical systems, replace components, or make adjustments to equipment with the electrical supply turned on. Under certain conditions, danger may exist even when the power control is in the "off" position due to charges retained by capacitors. To avoid injuries, always remove power from, discharge, and ground a circuit prior to servicing. Adhere to all lock-out/tag-out requirements.

MAINTENANCE STANDS AND FIXTURES

Ensure modules or assemblies are firmly secured to work stands or fixtures before performing maintenance procedures. Personal injury or damage to modules or assemblies may occur if a work stand or fixture slips.

METAL MACHINING PROCESSES

Metal machining processes may generate dust, fumes, filings, and/or shavings which may cause acute/chronic irritation to the skin, eyes, digestive tract, and respiratory system. Metallic dust vapors may form a fire hazard when exposed to heat, flame, or when in contact with oxidizing agents. Prior to performing any metal machining process, personnel shall consult their local safety and health staff and the Material Safety Data Sheet (MSDS) to become familiar with the hazards and protective measures for a specific metal.

SAFETY SUMMARY (continued)

MOVING ENGINE

Do not move an engine on work stand rails or transportation trailer without having installed proper supports, tierods, and flange adapters. Engine may shift or fall off rails and cause injury to personnel. When moving engine, do not push on engine. Use the engine support mount assemblies as a push point.

PACKING LUBRICATION (OIL AND FUEL SYSTEMS)

Use only the lubricant specified in the technical order to lubricate fuel and oil system packings. Use of an incompatible lubricant can cause oil foaming, clogging of critical fuel system filters, and packing deterioration leading to leakage, possible fire and engine shutdown.

PROTECTIVE CLOSURES AND COVERS

Install protective closures on all plumbing and components immediately upon removal. Install protective covers on engine modules, assemblies, parts, and compartments when not being worked.

QUICK RELEASE PINS

Do not force quick release pins into place as this may damage the self-locking feature of the pins. The compatibility of quick release pins is determined by the part number. Intermixing of pin part numbers during installation can result in loss of or failure of the quick release pins.

SHARP EDGED BLADES

Many blades have sharp edges. Wear protective gloves when handling bladed rotors and when installing or removing blades from rotors. Blades should only be used in their designed holder or rotor.

SUPER-CHILLED/HEATED PARTS AND EQUIPMENT

Super-chilled or heated parts and the equipment or agents used to heat or chill can cause burns, frostbite, or both. Wear temperature resistant gloves and other related protective clothing/equipment when handling chilled or heated parts or equipment. Super-chilled parts are fragile due to a lower resistance to impact. Heating parts beyond specified temperature limits can degrade heat treat qualities and result in part failure.

TEMPERATURE NORMALIZING

Allow heated or chilled parts to reach room temperature before applying final torque to fasteners. Failure to comply may result in improperly seated parts and/or mistorqued fasteners.

WORK BOLTS AND WORK NUTS

Work bolts and work nuts shall be permanently marked to distinguish them from engine bolts and nuts. Do not apply lubricants to work bolts and work nuts that will be replaced by engine bolts and nuts which require a thread sealant. Sealants will not adhere to threads contaminated with lubricants.

WORK PACKAGE

ALPHABETICAL INDEX

ENGINE TEST

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 10

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	27	5	27	8	23
2	24	6	24	9	24
3 - 4	23	7	21	10 Blank	9

ALPHABETICAL INDEX

ALPHABETICAL INDEX (continued)

ALPHABETICAL INDEX (continued)

ALPHABETICAL INDEX (continued)

ALPHABETICAL INDEX (continued)

ALPHABETICAL INDEX (continued)

ALPHABETICAL INDEX (continued)

ALPHABETICAL INDEX (continued)

WORK PACKAGE

INTRODUCTION

ENGINE TEST PROCEDURES

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	22				
3	9				
4 Blank	0				

1. INTRODUCTION.

a. This manual contains required overhaul instructions for testing and troubleshooting the F100-PW-229 turbofan engine.

2. TECHNICAL ORDER ARRANGEMENT.

a. This manual is arranged in six main groups. A block of work package numbers are assigned to each group. The groups are outlined as follows:

WP Block Numbers	Subject
001 00	Alphabetical Index
002 00	Introduction
003 00 through 099 00	Engine Dress
100 00 through 199 00	Engine Pretest
200 00 through 299 00	Engine Test
300 00 through 399 00	Engine Posttest
400 00 through 499 00	Engine Undress
500 00 and up	Troubleshooting

b. The engine is prepared for testing per requirements in work packages 003 00 through 199 00. These work packages contain instructions for dressing engine, installing engine in test cell, and servicing engine before testing.

c. The engine is tested per requirements in work packages 200 00 through 299 00.

d. After completion of any testing engine is serviced, undressed, and removed from test cell per requirements in work packages 300 00 through 399 00 and 400 00 through 499 00.

e. Engine troubleshooting work packages 500 00 and up include procedures for diagnosing and correcting engine malfunctions.

3. CHANGE REQUEST.

a. Recommendations for specific improvements or corrections to this technical order shall be submitted by AFTO Form 22 to SA-ALC/LPCQ (TOMA), Kelly AFB, TX 78241-6421 in accordance with T.O. 00-5-1.

4. TYPICAL PART NUMBER.

a. When the word TYPICAL precedes part number, that part number is one of several that may be used in that location. By referring to typical part number in the Illustrated Parts Breakdown (IPB) manual (T.O. 2J-F100-54), all applicable part numbers can be found.

b. Instructions in this technical order for typical part number also apply to the other (superseding) part numbers. When part number is used without word typical, it means that procedure applies only to that part number.

5. LOCALLY MANUFACTURED SUPPORT EQUIPMENT.

a. Locally manufactured support equipment may be manufactured by using activity or by a supplier.

b. Locally manufactured support equipment is listed in the Master Numerical List of Support Equipment in T.O. 2J-F100-53-3 and the Applicable Support and Illustrated Support Equipment sections of maintenance WPs/ SWPs.

c. Locally manufactured support equipment is identified in these WPs/SWPs by the prefix LM and a four digit number (LM 0123), or by the prefix LM followed by the PWA number (LM PWA 51203).

d. When an LM tool is identified in a maintenance WPs/SWPs, all data required to make the tool will be found in T.O. 2J-F100-53-3, WP 050 00.

6. INSTRUCTION CONFLICTS.

a. Instructions in this manual are to be used in conjunction with general series technical orders and other directives. Instructions in this manual shall take precedence if a conflict occurs.

WORK PACKAGE

ENGINE DRESS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 2

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	0				

1. INTRODUCTION.

a. This work package introduces the 003 00 through 099 00 series of work packages for engine dress procedures. The following work packages are included in this series:

WP No.	Title
004 00	Engine Transfer From Shipping Support to AF 8624150 Test Cell Adapter
005 00	Preliminary Engine Dress
006 00	Final Engine Dress
007 00 through 099 00	Open

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE TRANSFER FROM SHIPPING SUPPORT TO AF 8624150 TEST CELL ADAPTER

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 20

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	5	4 - 6	5	8	5
3	0	7	0	9 - 20	0

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test Starter Drive Assembly	T.O. 33D4-6-553-1
Engine Depot Test Adapter Kit	T.O. 33D4-6-572-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Engine Transfer From Shipping Support to Transfer Adapters	
	Adapter, Rail	PWA 51417
	Support - Transverse, Engine transferadapter	PWA 51415
	Adapter, Engine Transfer front	PWA 51921
	Adapter, Engine transfer rear	PWA 51920
	Trailer, Transportation	ALC 3000E
	The following are also required if shipping support is to be removed from trailer using hoist:	
	Adapter Sling, Engine handling rear	PWA 50336
	Sling, Engine handling	PWA 50301

APPLICABLE SUPPORT EQUIPMENT (continued)

Paragraph	Function - Tool Nomenclature	Tool Number
3	Engine Transfer from Transfer Adapters to Test Cell Adapter	
	Adapter Assembly, Engine test cell ---	AF 8624150
	Following are normally mounted on AF 8624150:	
	Bellmouth Extension kit ----------	PN 102375-001
	Starter, engine test ------------	PN 103-3018-1
	Screen, Bellmouth --------------	PWA 21591
	Bellmouth Assembly --------------	PWA 50487
	Seal ----------------------	PWA 56057

ILLUSTRATED SUPPORT EQUIPMENT

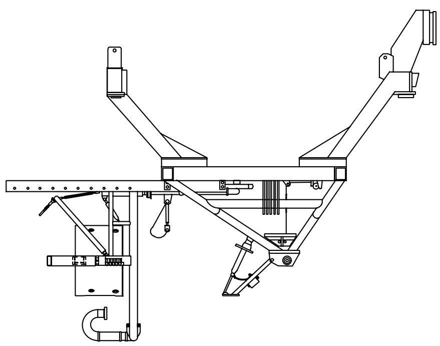


Figure T1. AF 8624150 Adapter

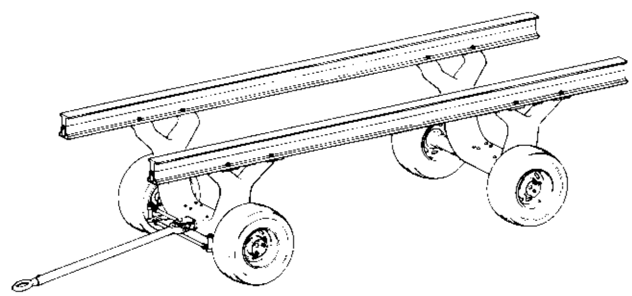


Figure T2. ALC 3000E Trailer

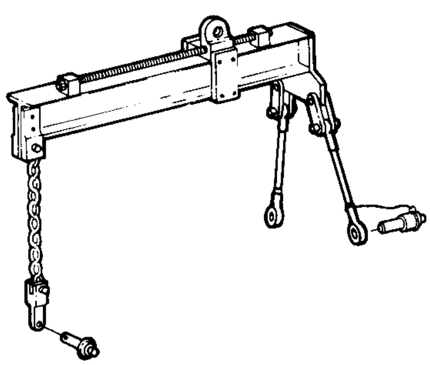


Figure T3. PWA 50301 Sling

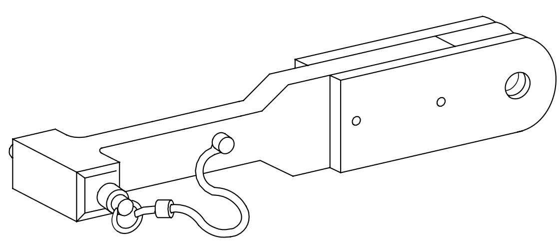


Figure T4. PWA 50336 Adapter

ILLUSTRATED SUPPORT EQUIPMENT (continued)

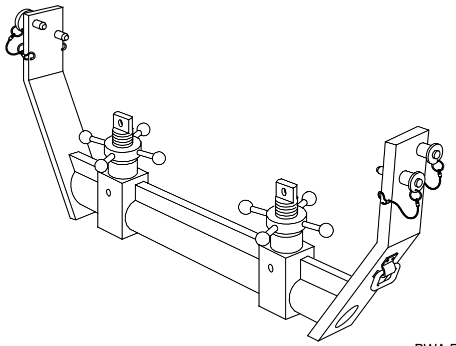


Figure T5. PWA 51415 Support

Figure T6. Deleted

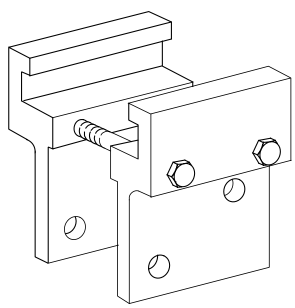


Figure T7. PWA 51417 Adapter

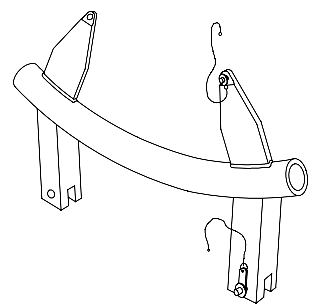


Figure T8. PWA 51920 Adapter

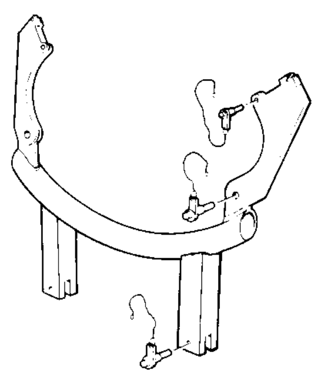


Figure T9. PWA 51921 Adapter

1. INTRODUCTION.

a. This work package contains procedures for transfer of engine from shipping support to engine test cell adapter.

2. ENGINE TRANSFER FROM SHIPPING SUPPORT TO TRANSFER ADAPTERS.
(See Figures 1 through 8.)

NOTE

Engine is supported on transportation trailer with shipping support assembly.

a. Temporarily support engine on transportation trailer as follows:
(See figures 1 through 6.)

(1) Disconnect shipping turnbuckle from lower handling mount on engine right side at Flanges H and J (see figure 1).

(2) Install four PWA 51417 adapters with Flange E-F and the other with Flanges H-J (see figure 2). Do not torque bolts at this time, tighten sufficiently to secure adapter to rails.

(3) Install two PWA 51415 transverse supports to PWA 51417 adapters (see figure 3). Secure using quick-release pins.

(4) Inspect headless pin on right and left side of engine Flange F. (See figure 4.) If pin is missing or loose, temporarily install quick-release pin.

(5) Install bracket details of PWA 51921 adapter on engine Flange F at 4 and 8 o’clock positions. Secure with quick-release pins (see figure 4).

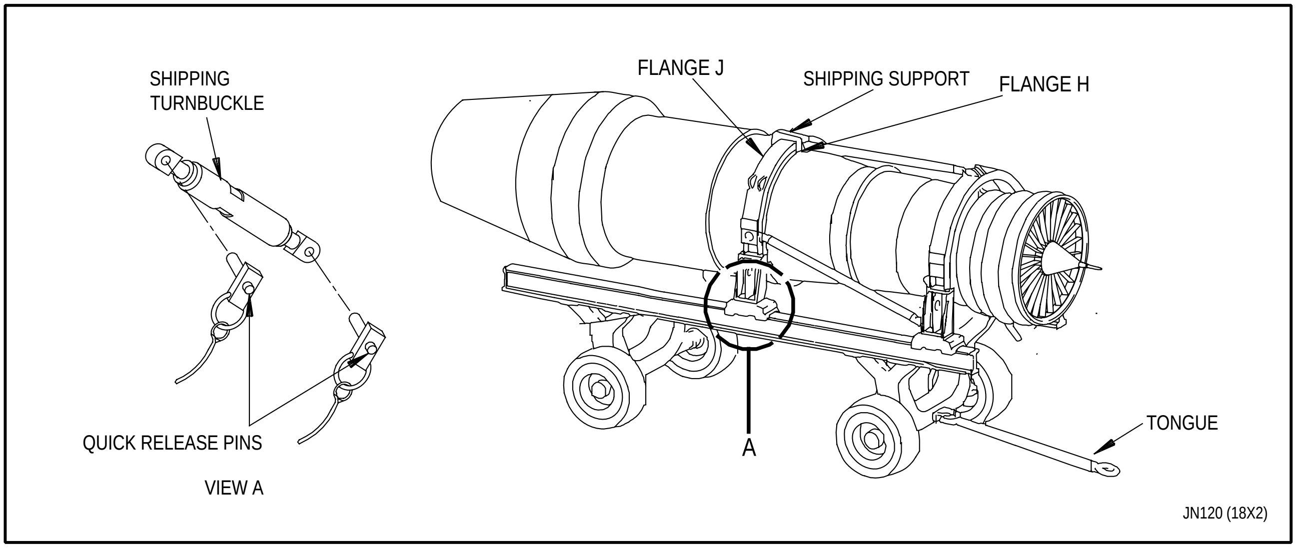


Figure 1. Right Side Rear Shipping Support Turnbuckle - Removal

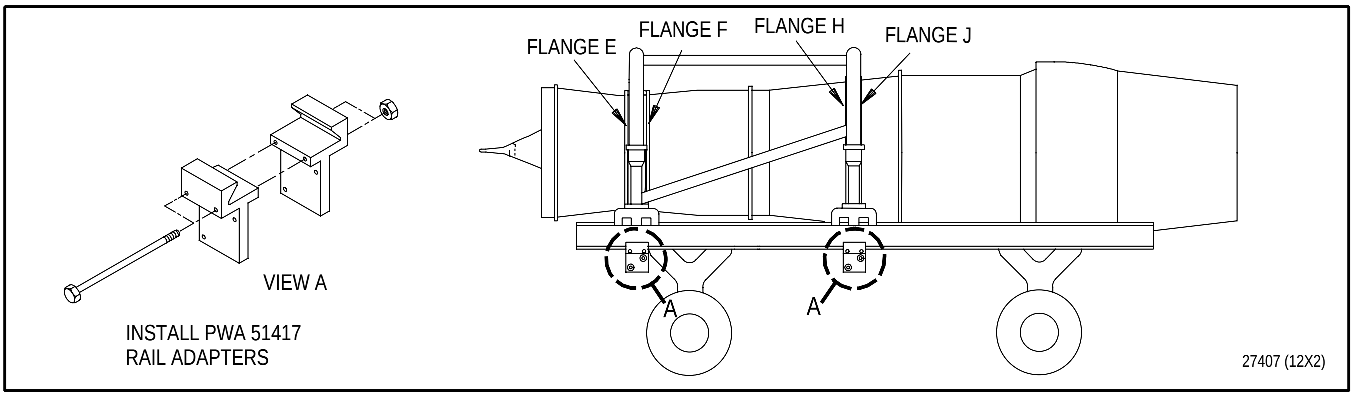


Figure 2. PWA 51417 Adapters - Installation

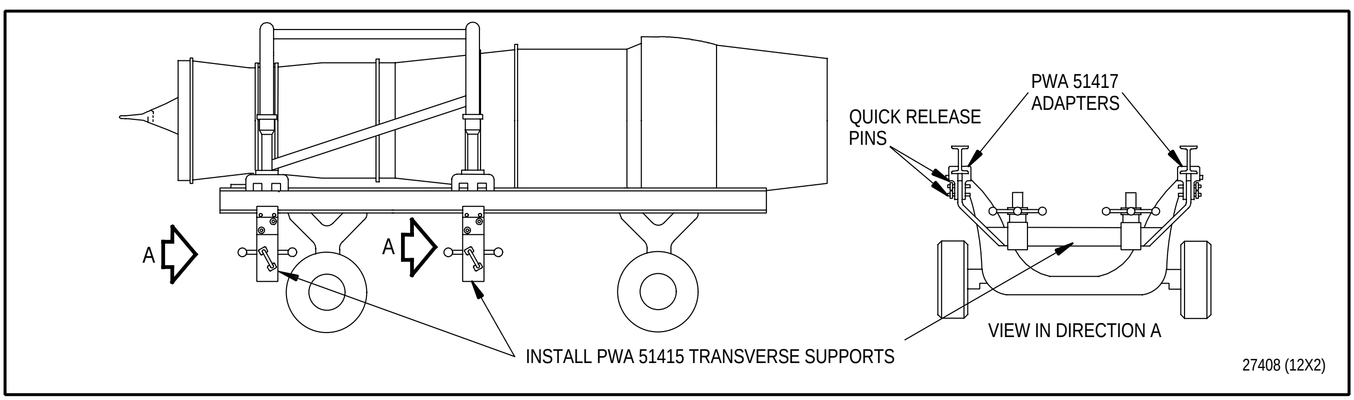


Figure 3. PWA 51415 Transverse Supports - Installation

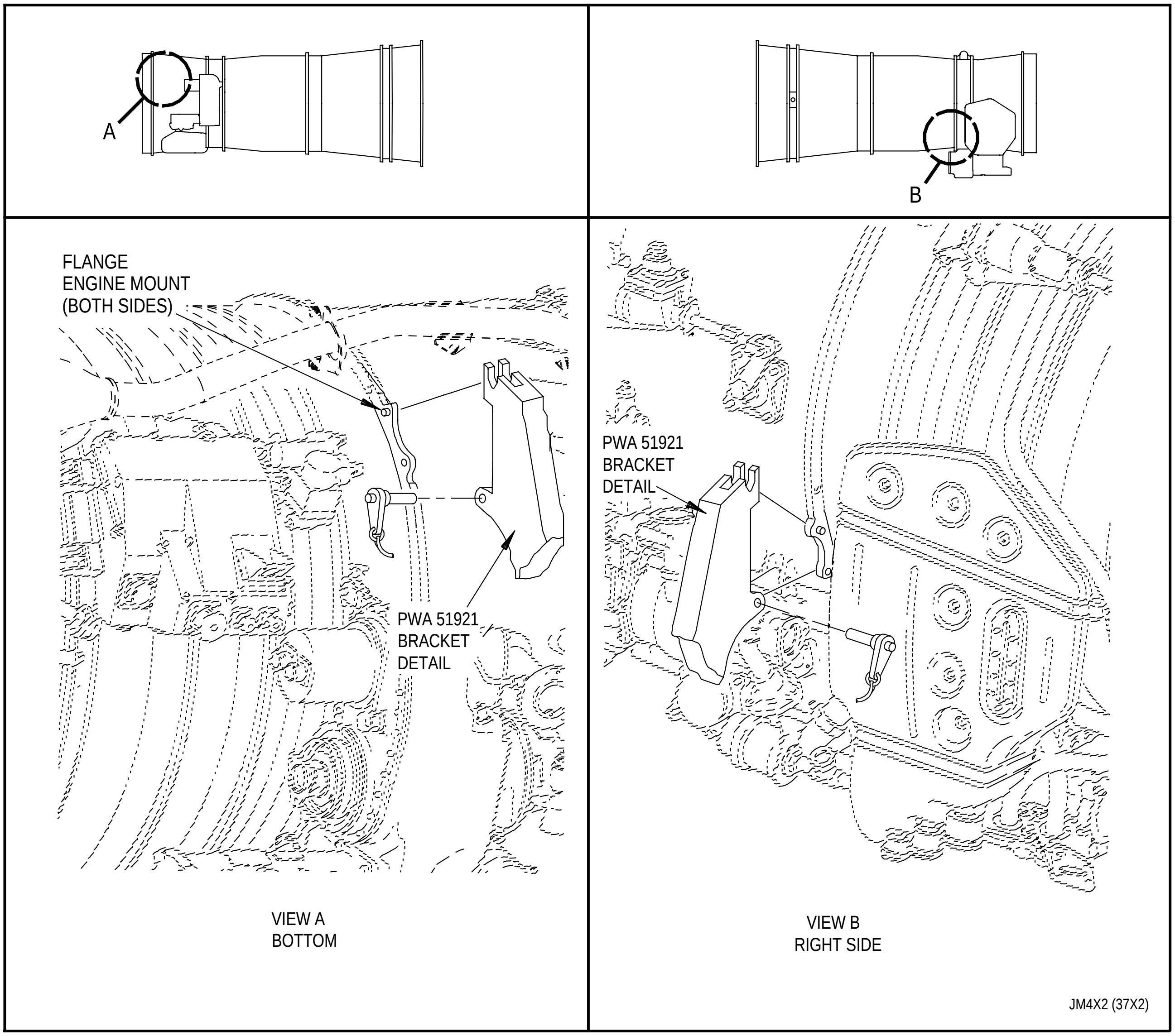


Figure 4. PWA 51921 Bracket Detail - Installation on Flange F

(6) Lower jackscrews on PWA 51415 transverse supports to gain clearance for installation of transfer adapters.

(7) Connect PWA 51921 front transfer adapter to bracket detail with quick-release pins.

(8) Install PWA 51920 rear transfer adapter as follows: (See figures 2, 5 and 6.)

(a) Remove bracket details from adapter.

(b) Install bracket to ground handling mount on bottom right side of engine Flanges H-J. Secure with detail pin.

(c) Install bracket to ground handling mount on bottom left side of engine Flanges H-J. Secure with detail pin.

(d) Install transfer adapter on rear transverse support. Secure with detail pins.

(e) Position transverse support so that transfer adapter aligns with bracket details.

(f) Raise jackscrews on transverse support to engage transfer adapter with bracket details. Align holes and install pin details.

WARNING

To prevent personnel injury, ensure detail bolts of PWA 51417 adapters are properly torqued.

(g) Torque detail bolts of four PWA 51417 adapters 600 to 650pound-inches.

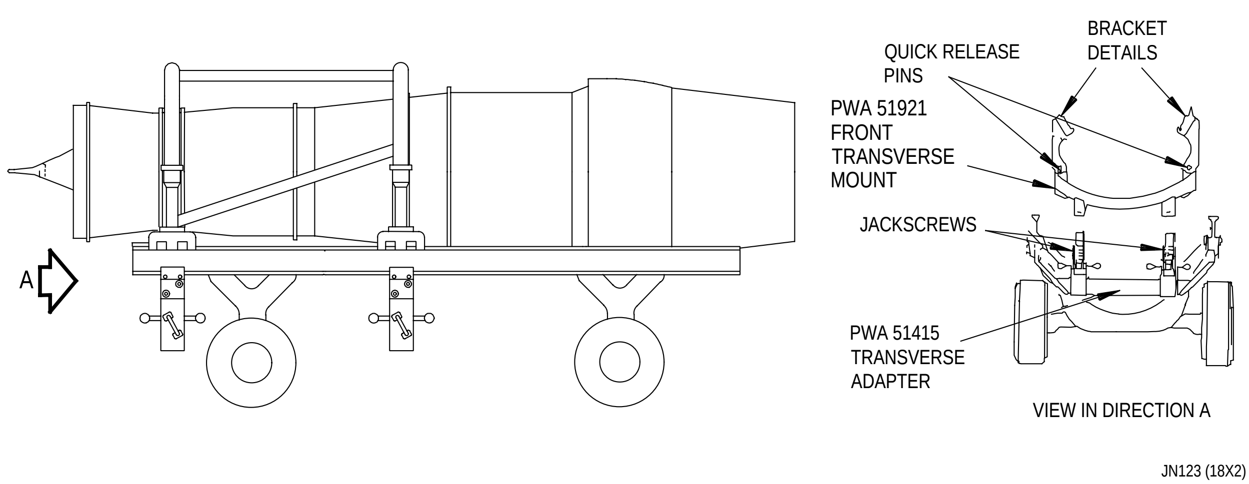


Figure 5. PWA 51921 Front Transfer Adapter - Installation

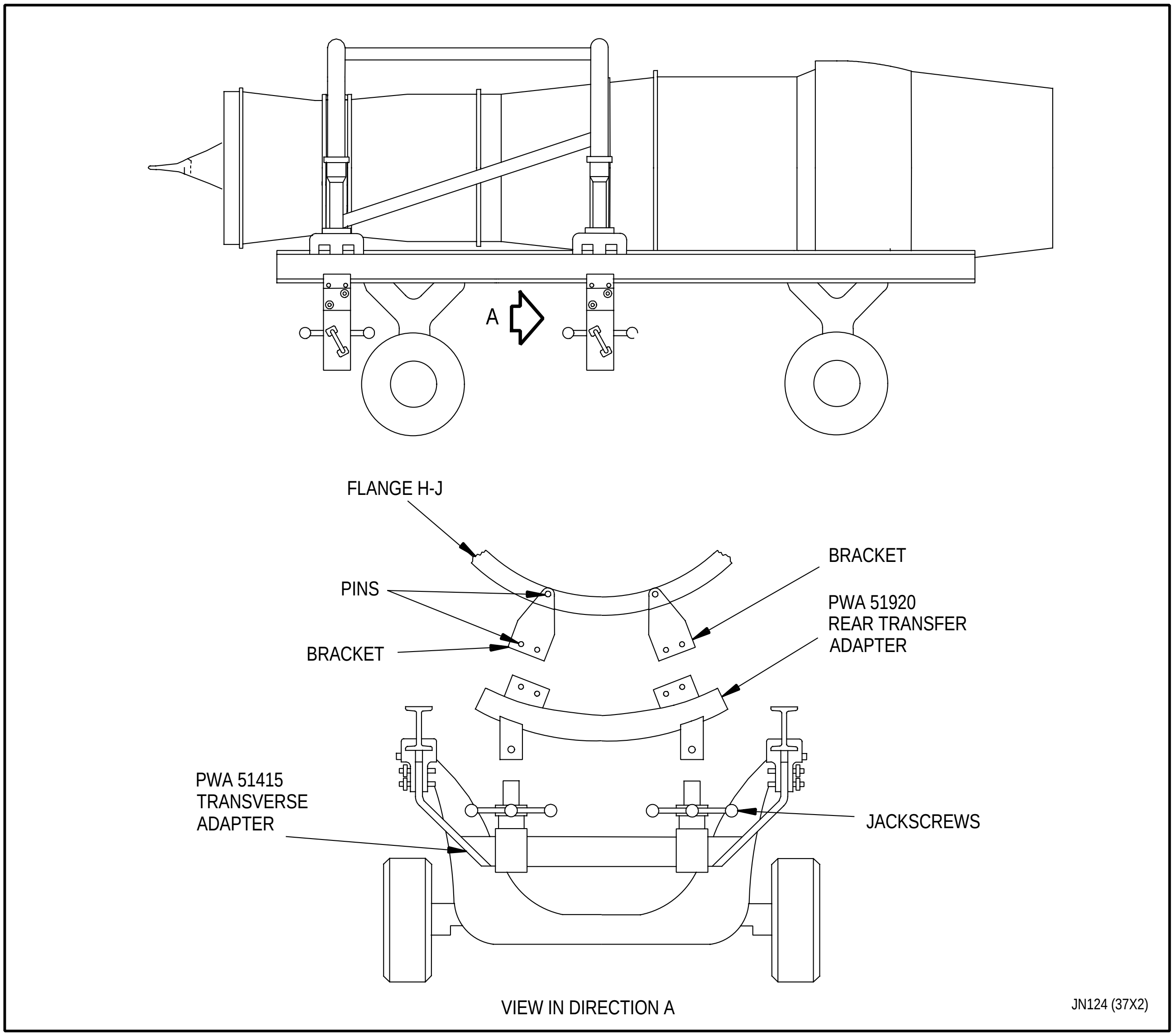


Figure 6. PWA 51920 Rear Transfer Adapter - Installation

b. Exchange engine shipping supports for test mount assemblies using hoist as follows: (See figures 1, 7, and 8.)

WARNING

Transverse supports are used to temporarily support engine. Do not move or work on engine while supported solely by transverse supports and associated hardware.

(1) Transfer weight of engine from shipping support to transverse supports by raising jackscrews.

(2) Remove pins securing shipping support clevis to engine. Remove locknuts, screws, and washers from shipping pins at 3 and 9 o’clock positions. Remove shipping pins.

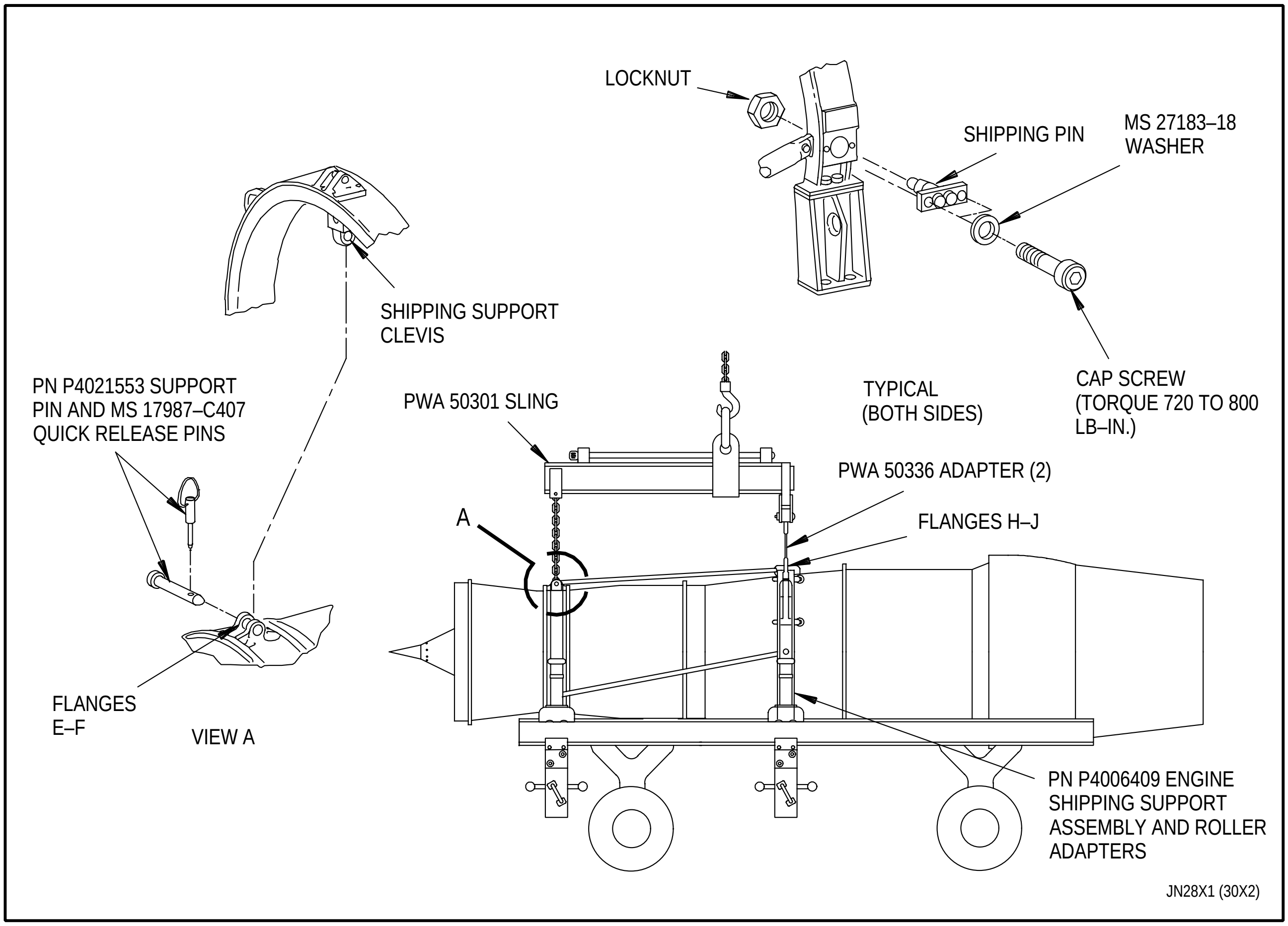


Figure 7. Disconnecting Engine From Shipping Support

(3) Connect PWA 50336 adapters to lugs on each side of aft end of shipping support assembly with pins.

(4) Position PWA 50301 sling over shipping support assembly using hoist.

(5) Connect PWA 50336 adapters to aft end of sling with pins.

(6) Connect front lug of sling to lugs at front top center of shipping support.

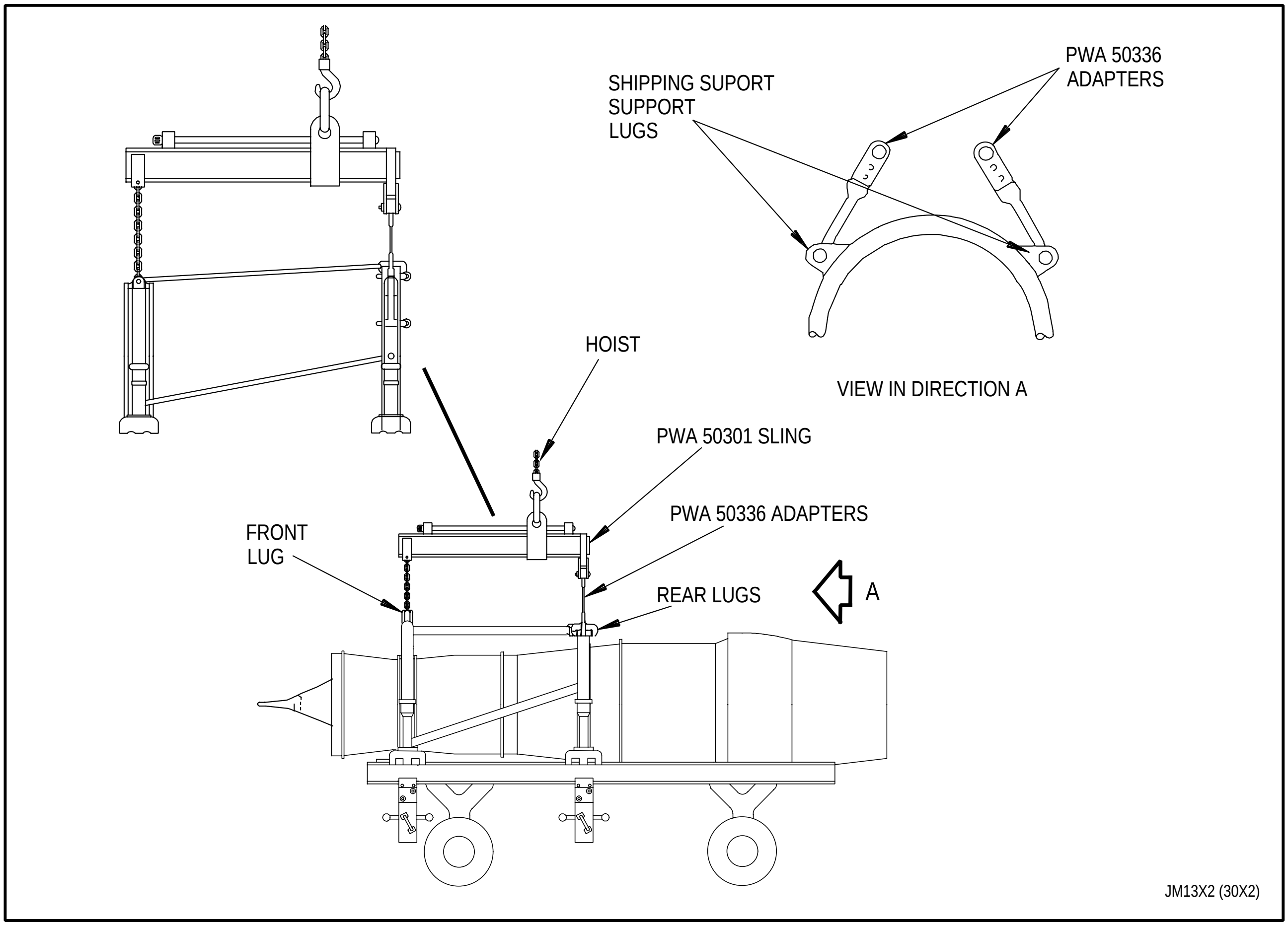


Figure 8. Shipping Support Assembly - Removal

NOTE

Roller adapters can be unlocked by inserting drive wrench in square hole of brake knob.

(7) Unlock shipping support roller adapters and lift shipping support assembly from trailer.

(8) Install shipping support details as follows: (See figures 1 and 7.)

(a) Remove clevis from intermediate case 12 o'clock position and secure to shipping support.

(b) Connect turnbuckle to right rear side of shipping support.

(c) Install shipping pins, cap screws, and nuts at 3 and 9 o'clock positions on shipping support.

3. ENGINE TRANSFER FROM TRANSFER ADAPTERS TO TEST CELL ADAPTER.

(See Figures 9 through 15.)

WARNING

Transverse supports are used to temporarily support engine while changing from shipping supports to engine test cell adapter. Do not move or work on engine while supported solely by transverse supports and associated hardware.

a. Position AF 8624150 test cell adapter as follows: (See figure 9 and 10.)

(1) Unlock bellmouth and starter detail of test cell adapter and move forward per T.O. 33D4-6-572-1. Lock adapter.

(2) Remove towing tongue from ALC 3000E transportation trailer.

CAUTION

Ensure adequate clearance between test cell and adapter engine/components is maintained during positioning of test cell adapter kit.

(3) Carefully position AF 8624150 test cell adapter back into position over engine on transportation trailer. Position so that mount lug at intermediate case 12 o'clock position is aligned with from connecting link on adapter and that vertical centerline of adapter is aligned with vertical centerline of engine along entire axial plane. (See figure 10.)

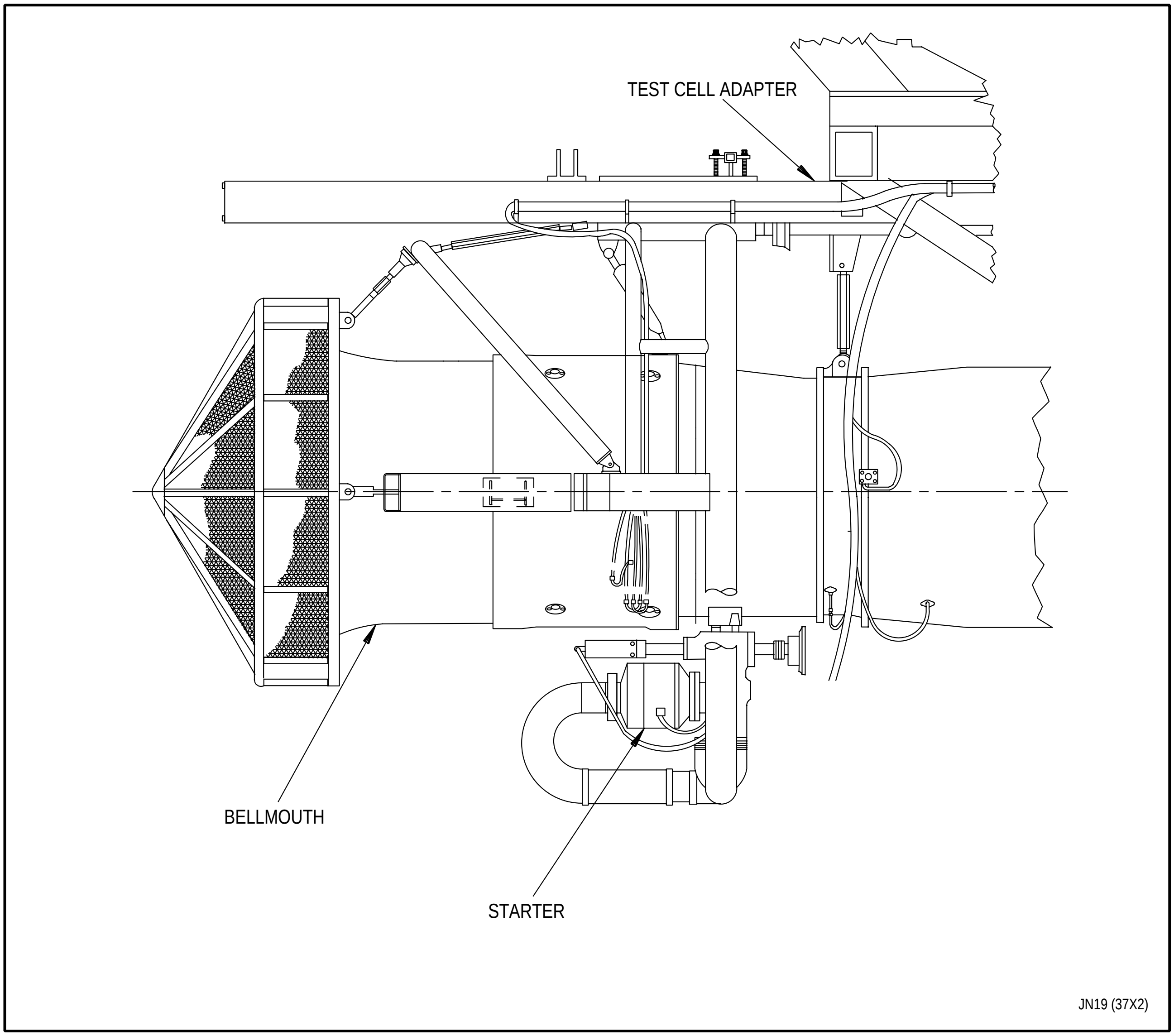


Figure 9. AF 8624150 Test Cell Adapter - Installed

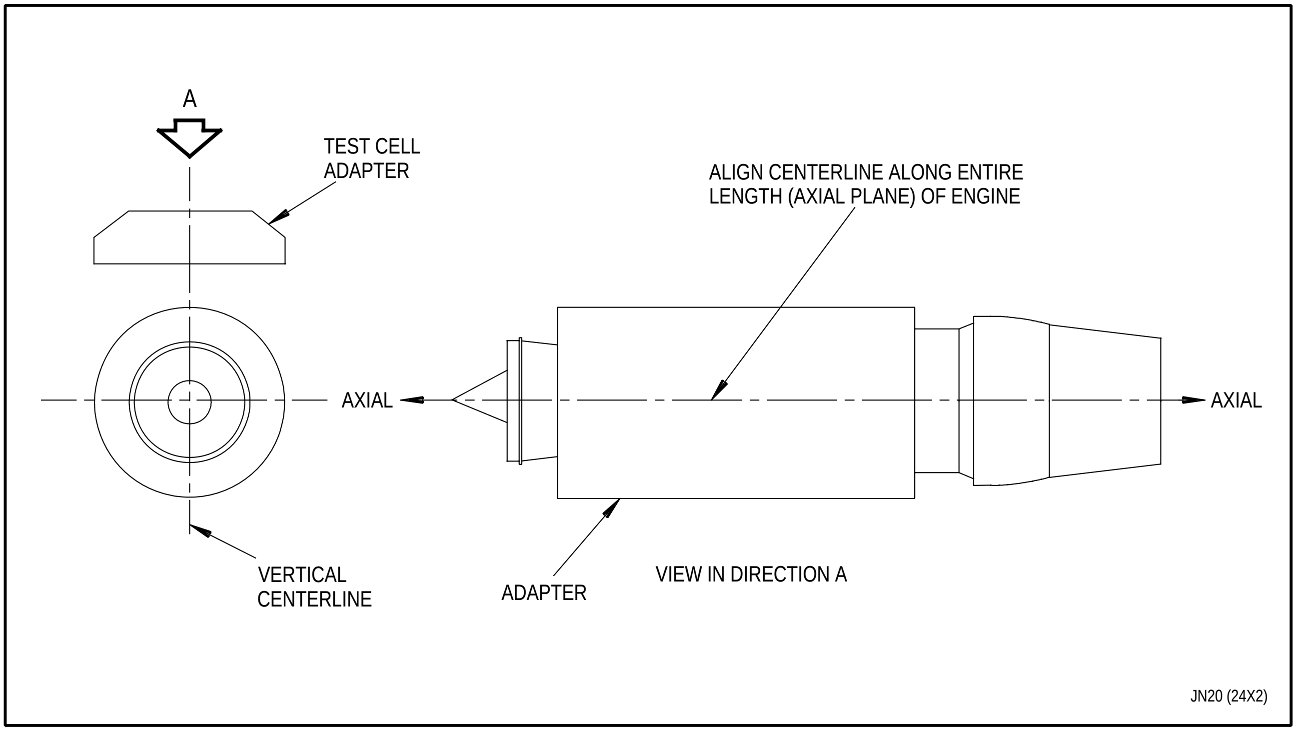


Figure 10. Alignment of Engine With Overhead Adapter

b. Attach front connecting link as follows: (See figure 11.)

(1) Lower connecting link down, using adapter front handwheel to align with holes in mount lug at Flanges E-F.

(2) Secure front connecting link of adapter to mount lug at 12 o’clock position on Flanges E-F by inserting straight pin. Secure straight pin using safety pin (View A).

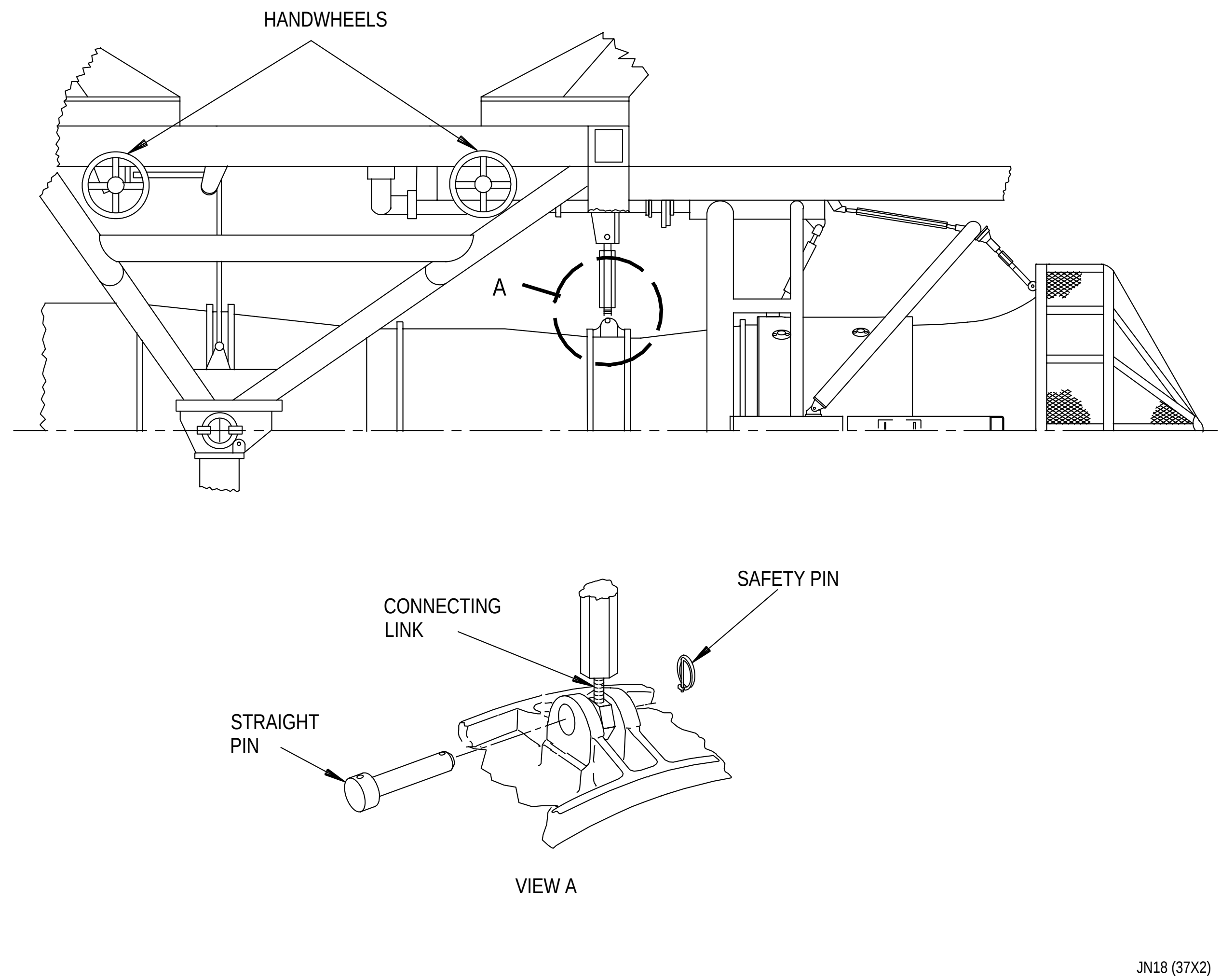


Figure 11. Securing Connecting Link to Intermediate Case

c. Attach lifting sling detail of adapter to clevis at end of rear winch cable on adapter.

d. Lower lifting sling detail using rear winch handwheel and secure sling to rear fan duct mounting Flanges H-J just above main thrust mounts at 3 and 9 o’clock positions using pins and safety pins. (See figure 12.)

e. Transfer engine weight from transfer adapters to test cell adapter lifting cables using winch handwheels.

f. Disconnect transfer adapters at Flanges H-J and bracket adapters at intermediate case.

g. Raise engine using handwheels until pin hole in upper end of front connecting link aligns with pin hole in adapter, and thrust pin mounts at rear of adapter at 3 and 9 o’clock positions are aligned with engine mount provisions at 3 and 9 o’clock. (See figures 13 and 14.)

h. Install thrust pins at 3 and 9 o’clock position as follows: (See figure 14.)

(1) Insert thrust pin into mount hole at Flanges H-J.

(2) Insert locking pin and secure using safety pin.

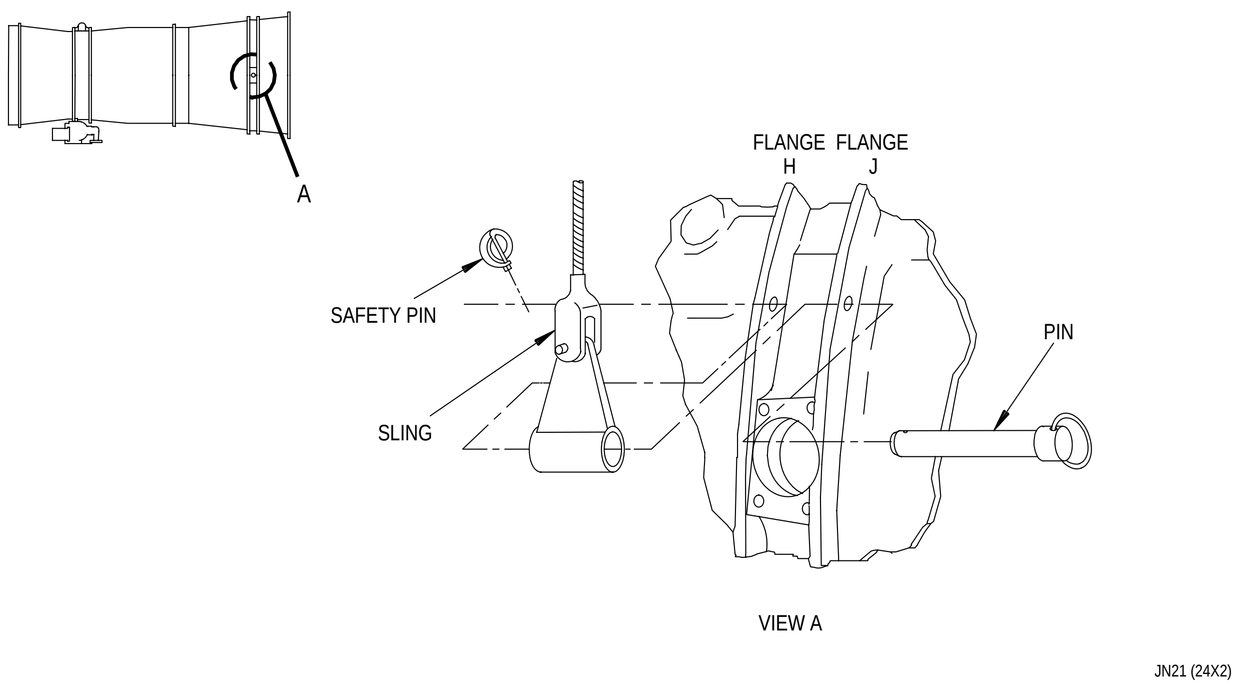


Figure 12. Flanges H-J (Typical Both Sides) Lifting Sling - Installation

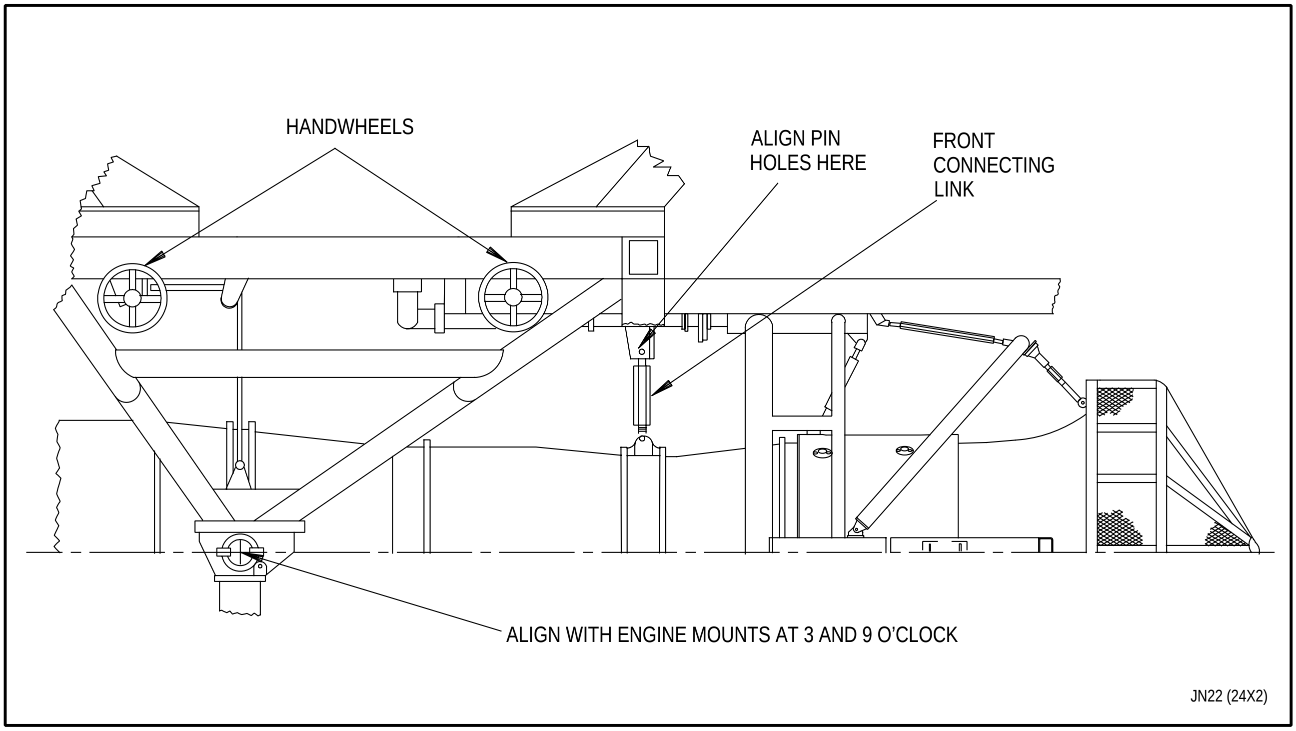


Figure 13. Aligning Engine Mounts With Test Cell Adapter

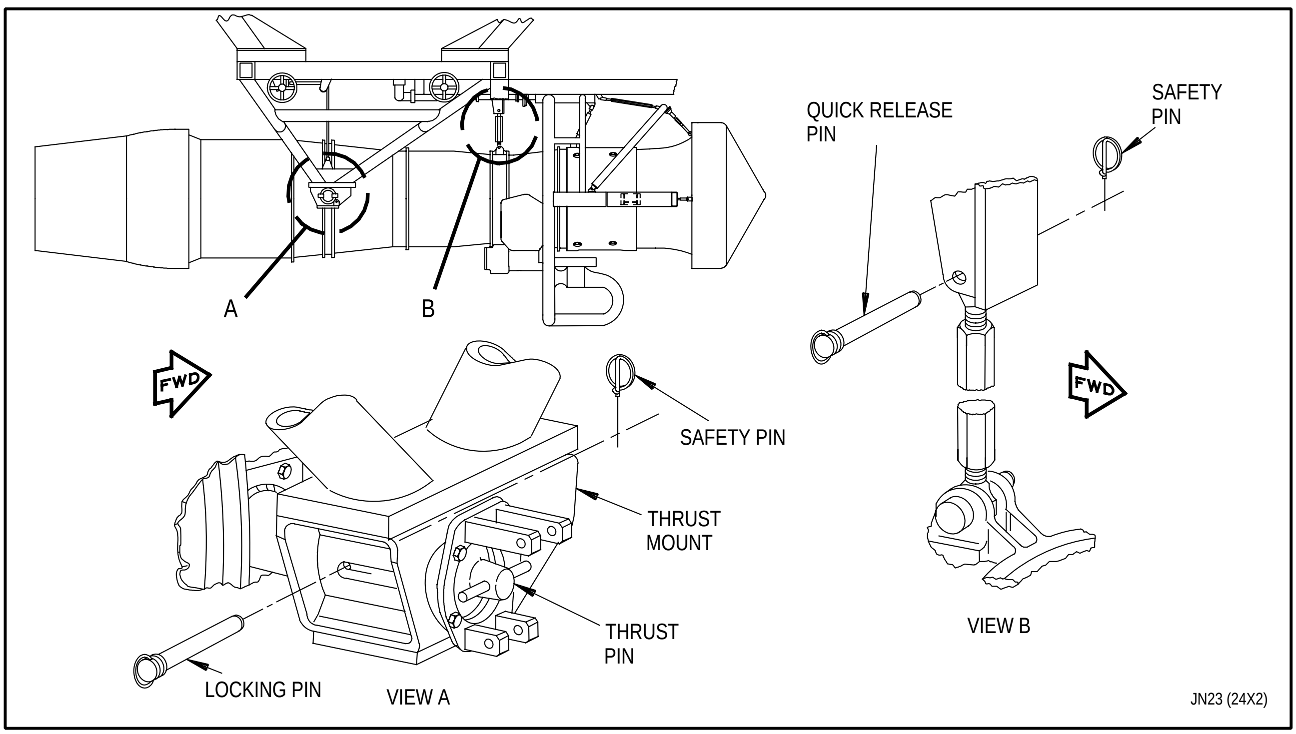


Figure 14. Securing Engine To Test Cell Adapter (Typical Both Sides)

i. Secure mount link at Flanges E-F by inserting quick-release pin through aligned holes at upper end. Secure using safety pin. (See figure 14.)

CAUTION

Do not use excessive force to install ball lock pins. Use of excessive force can damage locking feature of pin.

j. Install antichuck linkage as follows: (See figure 15.)

(1) Align antichuck arm with brackets at main engine mount at Flanges H-J on engine right side. Secure using ball lock pins.

(2) Insert nonadjustable end of antichuck link into mounting provision at approximate 4 o’clock position at Flanges H-J. Secure using ball lock pin.

(3) Align adjustable end of link with hole in antichuck arm. If necessary, adjust to obtain alignment and tighten locknut. Secure using ball lock pin.

k. Disconnect and remove rear adapter sling from Flanges H-J and rear winch clevis.

CAUTION

Ensure no interference between engine and transfer adapter on transportation trailer exist. If necessary lower hand jacks on transverse adapters to gain clearance for removal of trailer.

l. Remove transportation trailer from under engine.

m. Remove bracket details of PWA 51921 adapter from left and right side of Flange F.

n. If not previously accomplished, check that engine is level. Refer to T.O. 33D4-6-572-1.

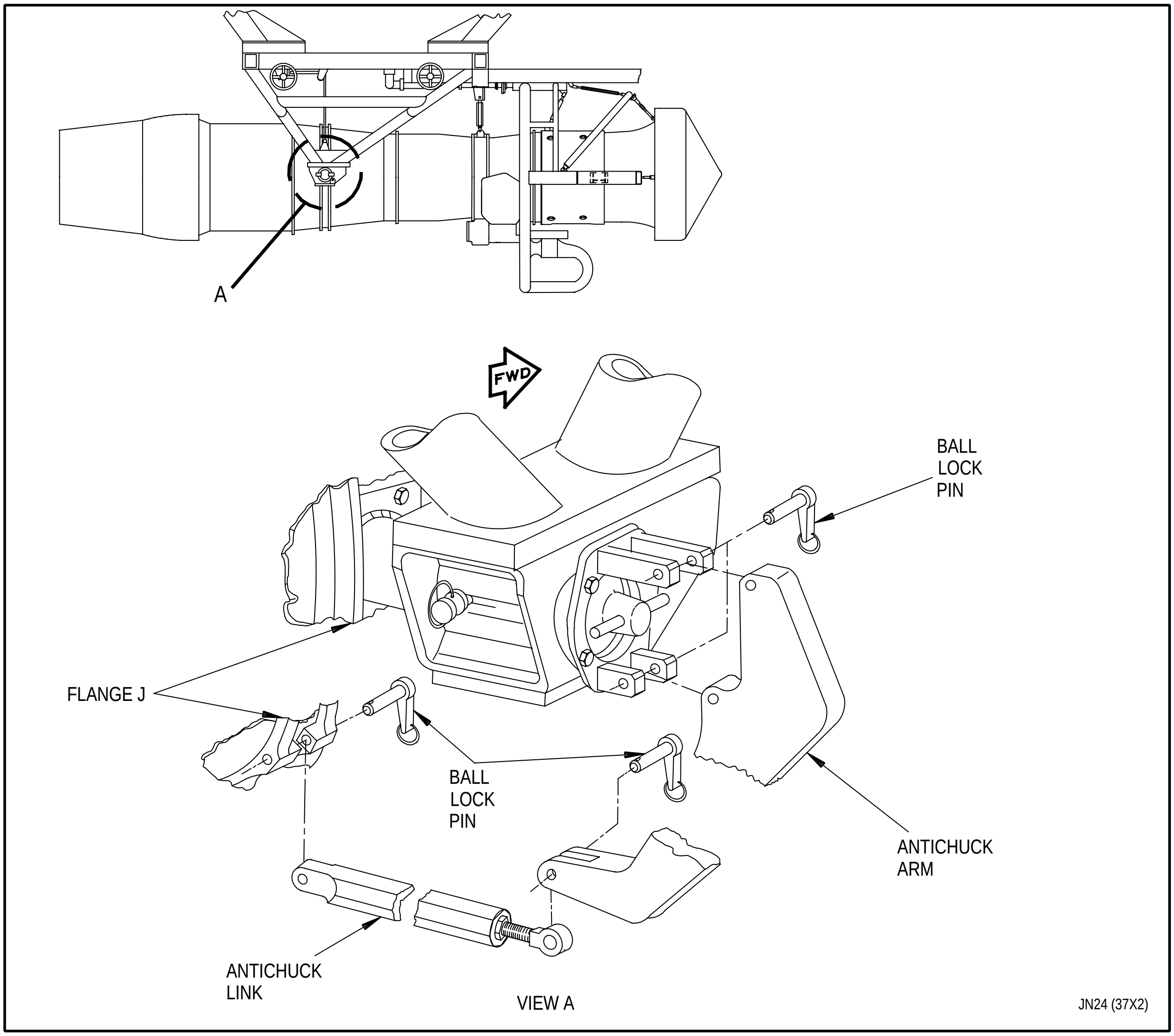


Figure 15. Antichuck Linkage - Installation

CAUTION

Failure to lubricate starter gearbox needle bearing and oil service starter gearbox (daily) will cause starter gearbox to fail.

o. Daily inspection and servicing of starter gearbox is mandatory. Inspect and service starter gearbox as follows:

(1) Check oil level indicated on oil level sight gage on lower rear side of starter gearbox housing.

(2) If gearbox oil servicing is required, remove pipe plug at 12 o’clock position on gearbox housing and oil service gearbox per T.O. 33D4-6-553-1.

(3) Lubricate needle bearings located at air cylinder-gearbox interface daily.

WORK PACKAGE

TECHNICAL PROCEDURES

PRELIMINARY ENGINE DRESS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 22

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	7	8 - 12	7	13 - 14	7
3 - 4	0	12A Added	7	15 - 17	0
5	6	12B Blank Added	7	18 - 19	6
6 - 7	3			20	0

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Accessories and Rigging Procedures -----------	T.O. 2J-F100-53-4
Cylinders - Actuating, Linear, Variable Vane, Rear Compressor	WP 034 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
Compound, antigalling (PWA 550)	Hi-T-650 or Lubri-Bond HT
Compound, cleaning	MIL-C-87937 Type I or
Solvent, petrolem	P-D-680, Type II, or Type III
Lockwire (0.032 inch diameter)	MS9226-04
Oil, lubricating	MIL-L-7808 or
Petrolatum (alternate to oil)	VV-P-236

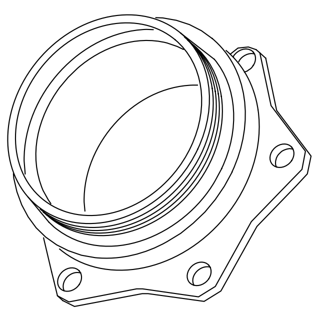
EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

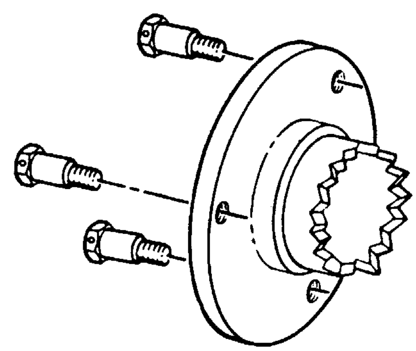
Paragraph	Function - Tool Nomenclature	Tool Number
2	Preliminary Engine Dress	
	Coupling, Fuel supply -------------------	PN 103-2032-1 or PN 4039184
	Jaw Assembly, Starter driveshaft ------------	PN 103-2033-7
	Bracket - Vibration, Gearbox pickup ----------	PN 103-2042-1
	Probe Assembly, Temperature (MOT) and pressure (Popd) ------------------------------	PN 103-2052-1
	Band Assembly, Augmentor nozzle ------------	PN 103-2081-1
	Wrench ------------------------------	PN 103-2092-1B
	Bracket - Vibration, Inlet case ------------	PN 164-1022-1
	Accelerometer (four required) --------------	PN 2271A (typical)

ILLUSTRATED SUPPORT EQUIPMENT



PN 4039184 –C

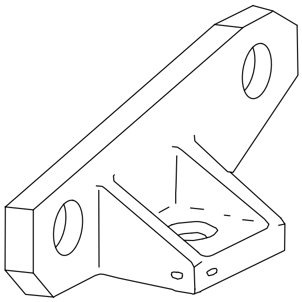
Figure T1. PN 103-2032-1 or PN 4039184 Fuel Supply Coupling (Typical Design)



PN 103–2033–4D –C

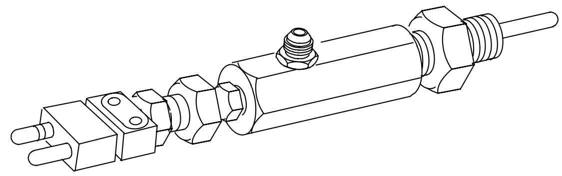
Figure T2. PN 103-2033-7 Jaw

ILLUSTRATED SUPPORT EQUIPMENT (continued)



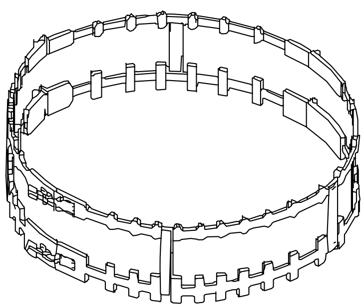
PN 10320421 –C

Figure T3. PN 103-2042-1 Bracket



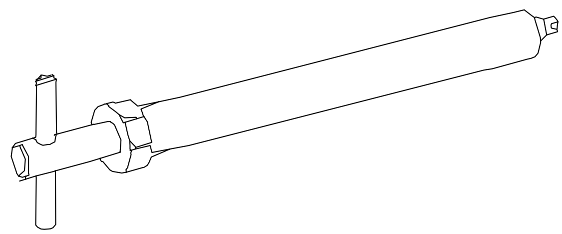
PN 10320521 –C

Figure T4. PN 103-2052-1 Probe



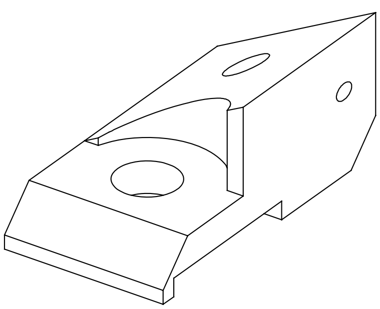
PN 10320811 –C

Figure T5. PN 103-2081-1 Band



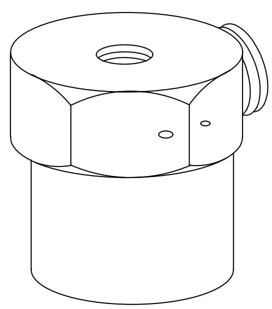
PN 10320921 –C

Figure T6. PN 103-2092-1B Wrench



PN 16410221 –C

Figure T7. PN 164-1022-1 Bracket



PN 2271A –C

Figure T8. PN 2271A Accelerometer Transducer

1. INTRODUCTION.

This work package contains instructions for preliminary engine dress. This procedure may be performed with the engine in shop or on the test cell.

2. PRELIMINARY ENGINE DRESS.

(See Figures 1 through 11.)

a. Install PN 103-2033-7 starter coupling jaw as follows: (See figure 1.)

(1) Install starter coupling jaw on remote gearbox driveshaft coupling (gearbox PTO pad).

(2) Secure with detail PN 103-2034-1 bolts.

(3) Torque bolts 50 to 70 pound-inches.

(4) Single strand lockwire bolts with PN MS9226-04 wire.

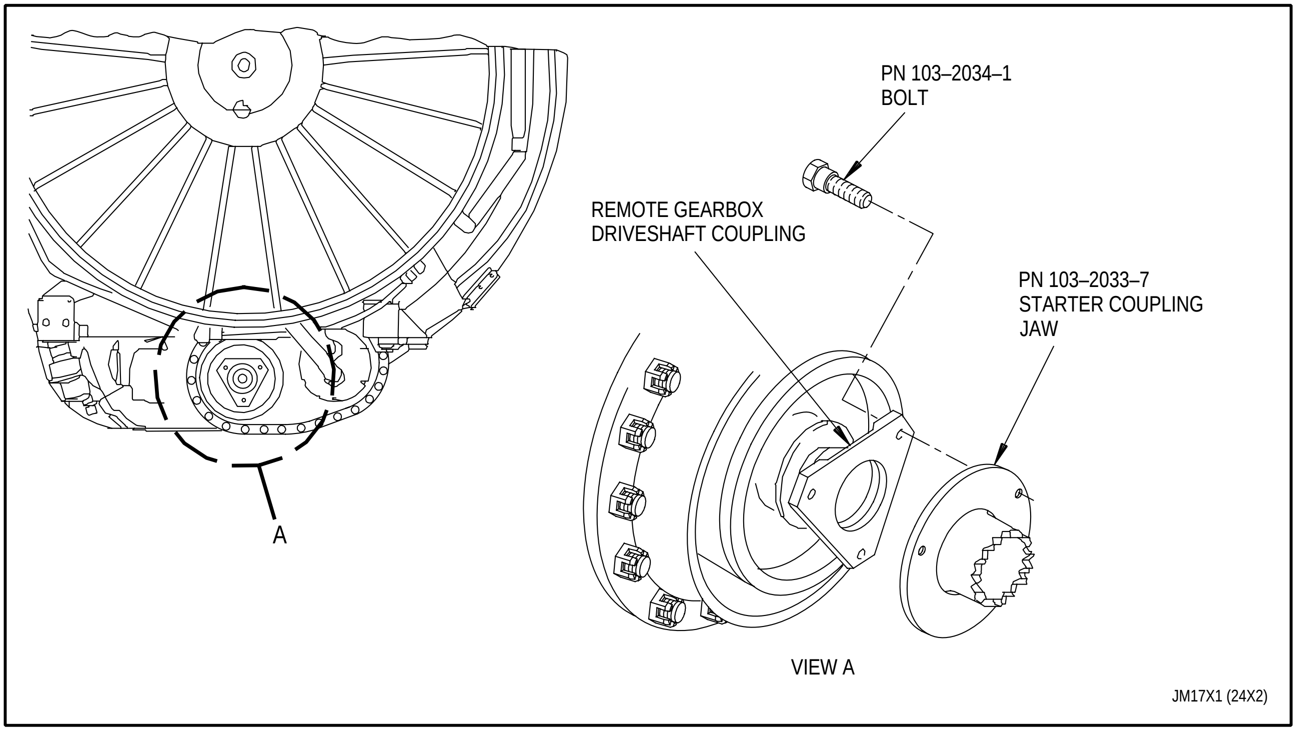


Figure 1. Starter Coupling Jaw - Installation

WARNING

Due to location of Ps2 probe, care shall be taken not to strike probe which can cause injury.

NOTE

Vibration analysis is required only during engine acceptance tests and vibration monitoring per WP 212 00 and WP 218 00.

b. Install fan inlet case, gearbox, compressor case, and rear compressor drive turbine case vibration accelerometers as follows:

(1) Install fan inlet case accelerometer as follows: (See figure 2.)

(a) Remove lower Tt2B bolt at approximately 4:00 o’clock position (as viewed from front of engine) on fan inlet case.

(b) Install PN 2271A accelerometer on PN 164-1022-1 bracket.

(c) Torque accelerometer 16 to 20 pound-inches. Lockwire bracket and accelerometer with PN MS9226-04 wire.

NOTE

Ensure bracket and accelerometer are positioned in front of Tt2 probe (toward front of engine), and accelerometer is setting vertical relative to ground.

(d) Install PN 164-1022-1 accelerometer bracket on fan inlet case (lower Tt2B mount) using bolt. Torque 27 to 30 pound-inches.

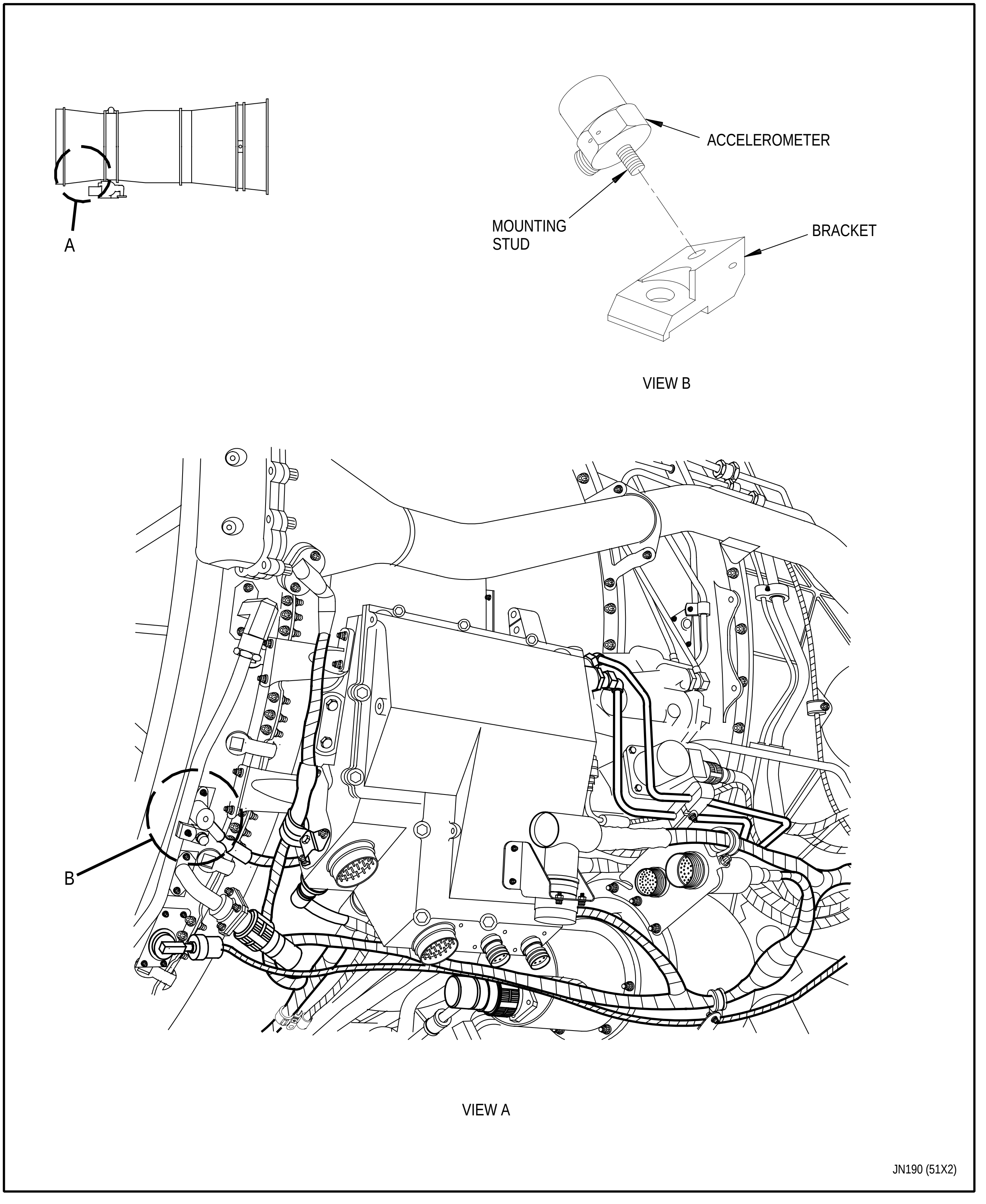


Figure 2. Fan Inlet Case Accelerometer - Installation

(2) Install gearbox accelerometer assembly as follows: (See figure 3.)

(a) Install PN 2271A accelerometer on PN 103-2042-1 mount bracket and secure with attachment screw.

(b) Torque bolt 16 to 20 pound-inches.

(c) Lockwire screw, bracket, and accelerometer using PN MS9226-04 wire.

(d) Install accelerometer and bracket on bottom of gearbox forward flange using existing studs, washers, and nuts.

(e) Torque nuts 54 to 60 pound-inches.

(3) Install PN 164-1025-1 AP-3 vibration probe and accelerometer as follows: (See figures 4 and 5.)

(a) Apply engine oil MIL-L-7808 or equivalent to threads of studs (4) and nuts (3).

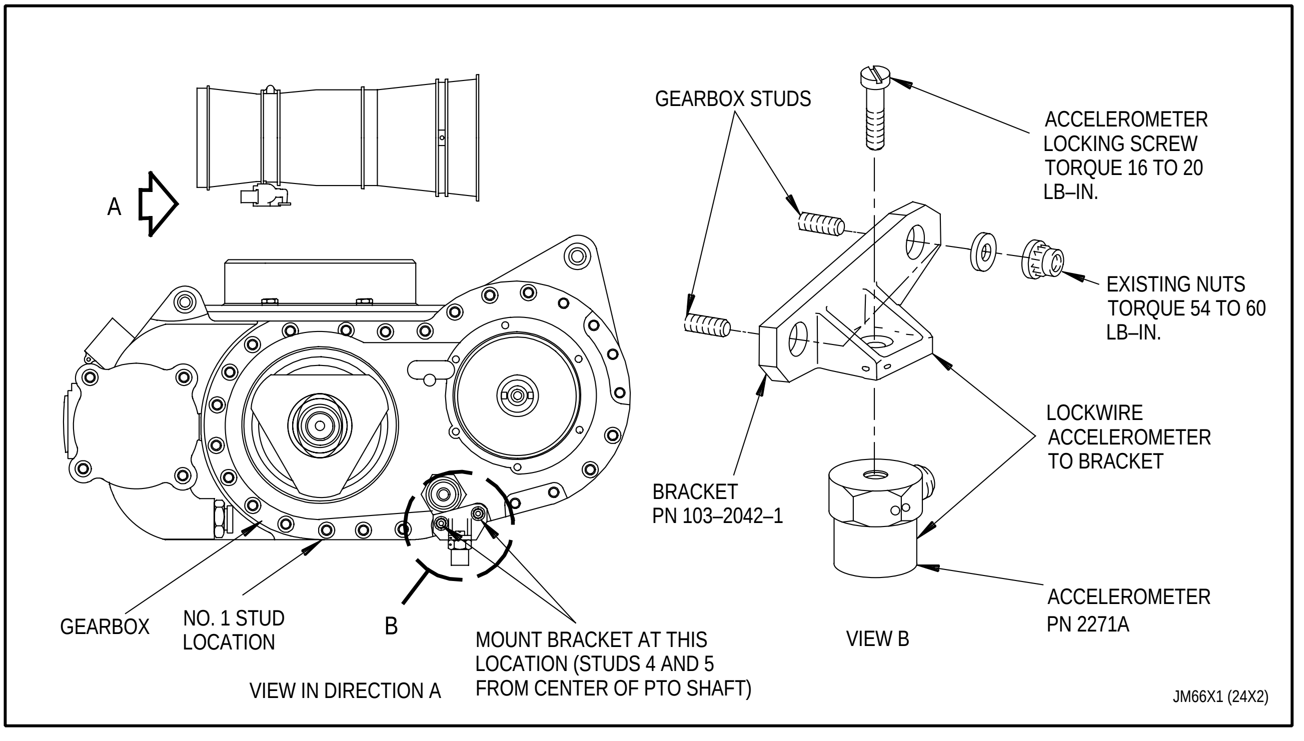


Figure 3. Gearbox Vibration Accelerometer and Bracket - Installation

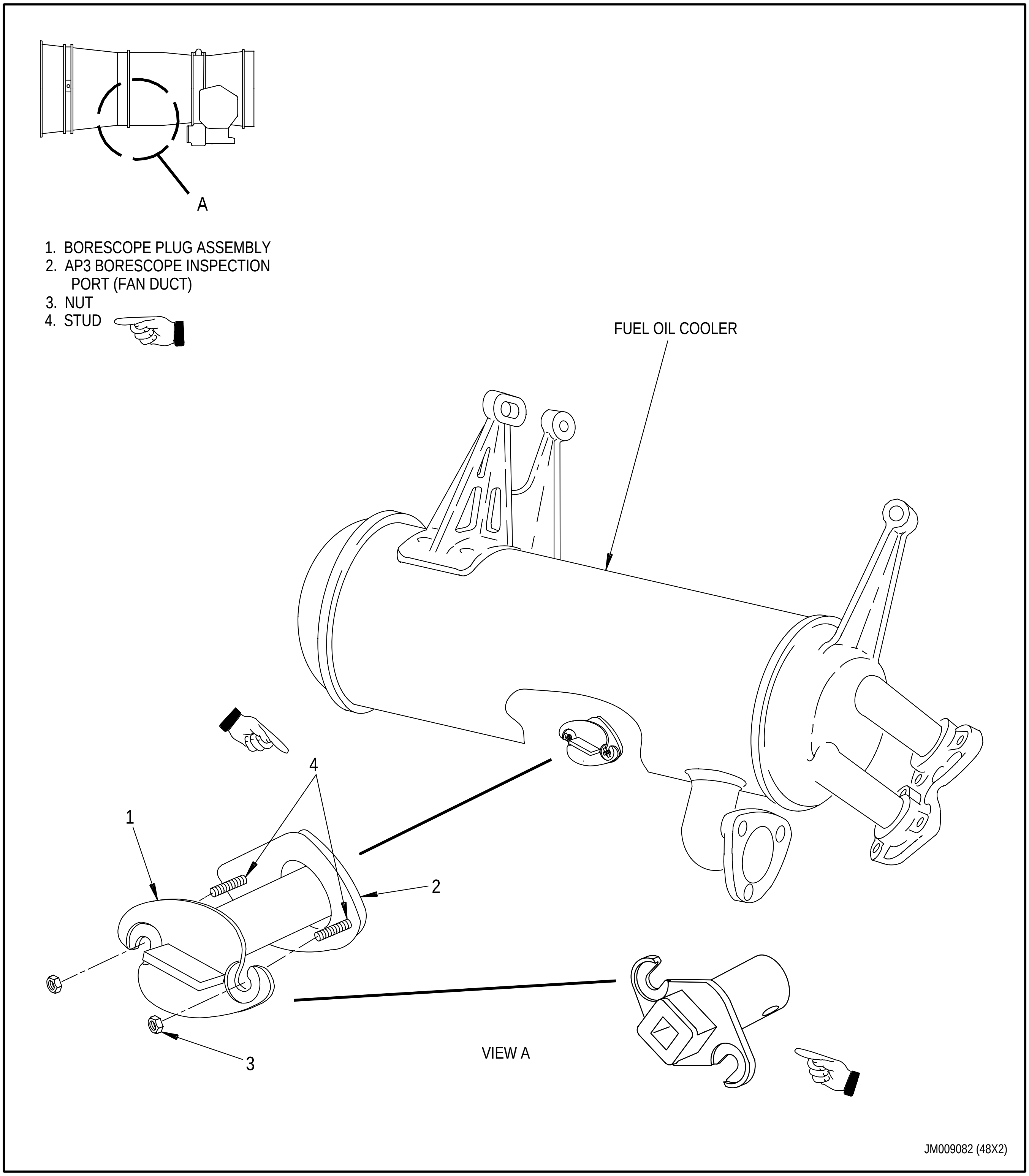


Figure 4. AP-3 Borescope Plug Assembly - Removal

(b) Remove nuts (3) alternately a maximum of 2 turns at a time until borescope plug (1) spring load is disengaged.

NOTE

There are two configurations of borescope plugs:

- Flat tab plug rotates clockwise to disengage.
- 3/8 inch drive plug rotates counterclockwise to disengage.

(c) Rotate borescope plug to disengage studs and remove from boss in outer front fan duct.

(d) Remove nuts (3) and retain for reinstallation after test.

(e) Remove locking nut(1, figure 5) from vibration probe(4).

(f) Apply a light coat of MIL-L-7808 or petrolatum VV-P-236 to ring in cover assembly(3).

(g) Install cover assembly(3) (red side facing out) onto studs on fan duct port boss. Torque nuts(5) 23 to 26 pound-inches.

(h) Install locking nut(1) on vibration probe(4) exposing approximately three threads.

(i) Install PN 2271A accelerometer(2) on vibration probe assembly. Torque locking nut(1) to accelerometer(2) 16 to 20 pound-inches.

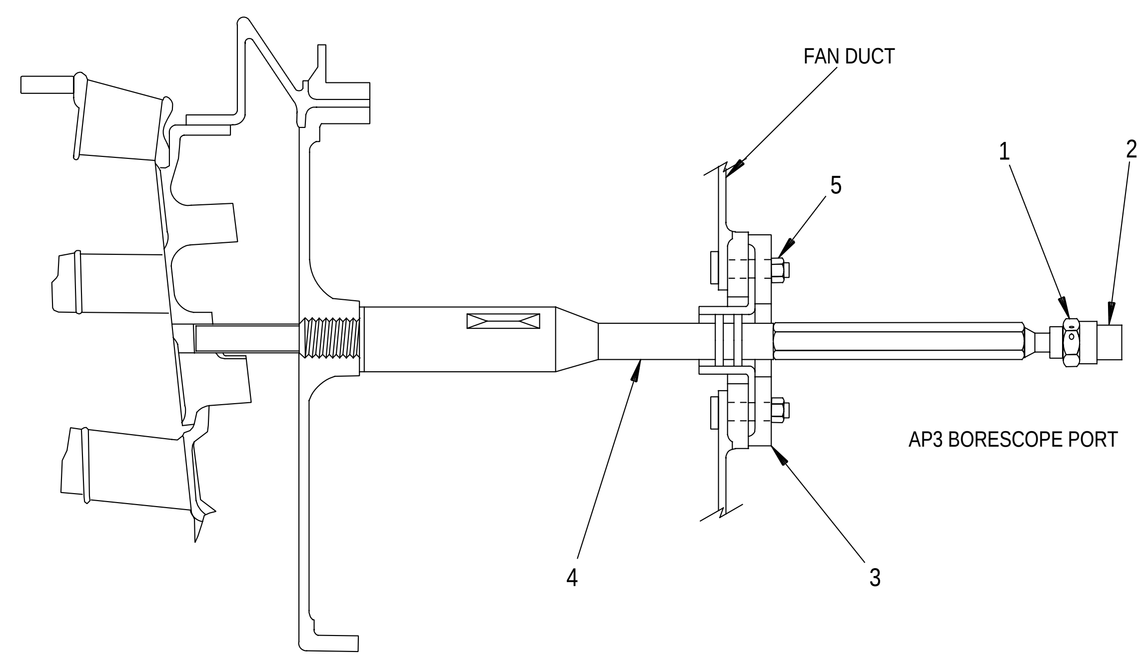


Figure 5. AP-3 Vibration Probe and Accelerometer - Installation

(4) Install 164-1026-1 AP-6 vibration probe and accelerometer assembly as follows: (See figures 6, 7, and 7A.)

(a) Apply engine oil or equivalent to threads of studs (4) and nuts (2).

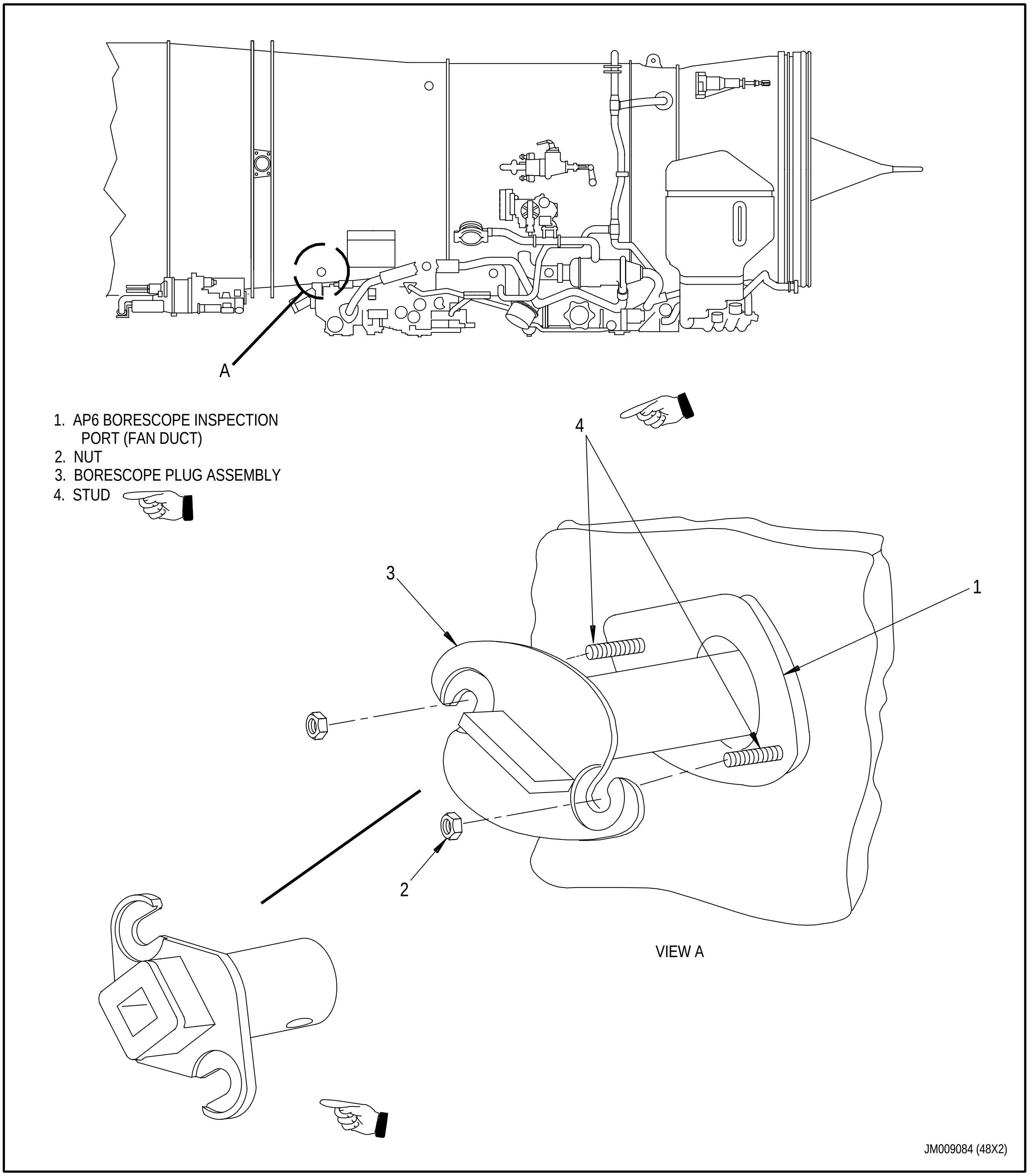


Figure 6. AP6 Borescope Plug Assembly - Removal

(b) Remove nuts (2) alternately a maximum of 2 turns at a time until borescope plug (3) spring load is disengaged.

NOTE

There are two configurations of borescope plugs:

- Flat tab plug rotates clockwise to disengage.
- 3/8 inch drive plug rotates counterclockwise to disengage.

(c) Rotate borescope plug to disengage studs and remove from boss in outer rear fan duct.

(d) Remove nuts (2) and retain for reinstallation after test.

(e) Remove base plate(6) and seal plate assembly(5) from vibration probe(7).

(f) Unscrew inner rod detail(4) of vibration probe(7) until bottomed.

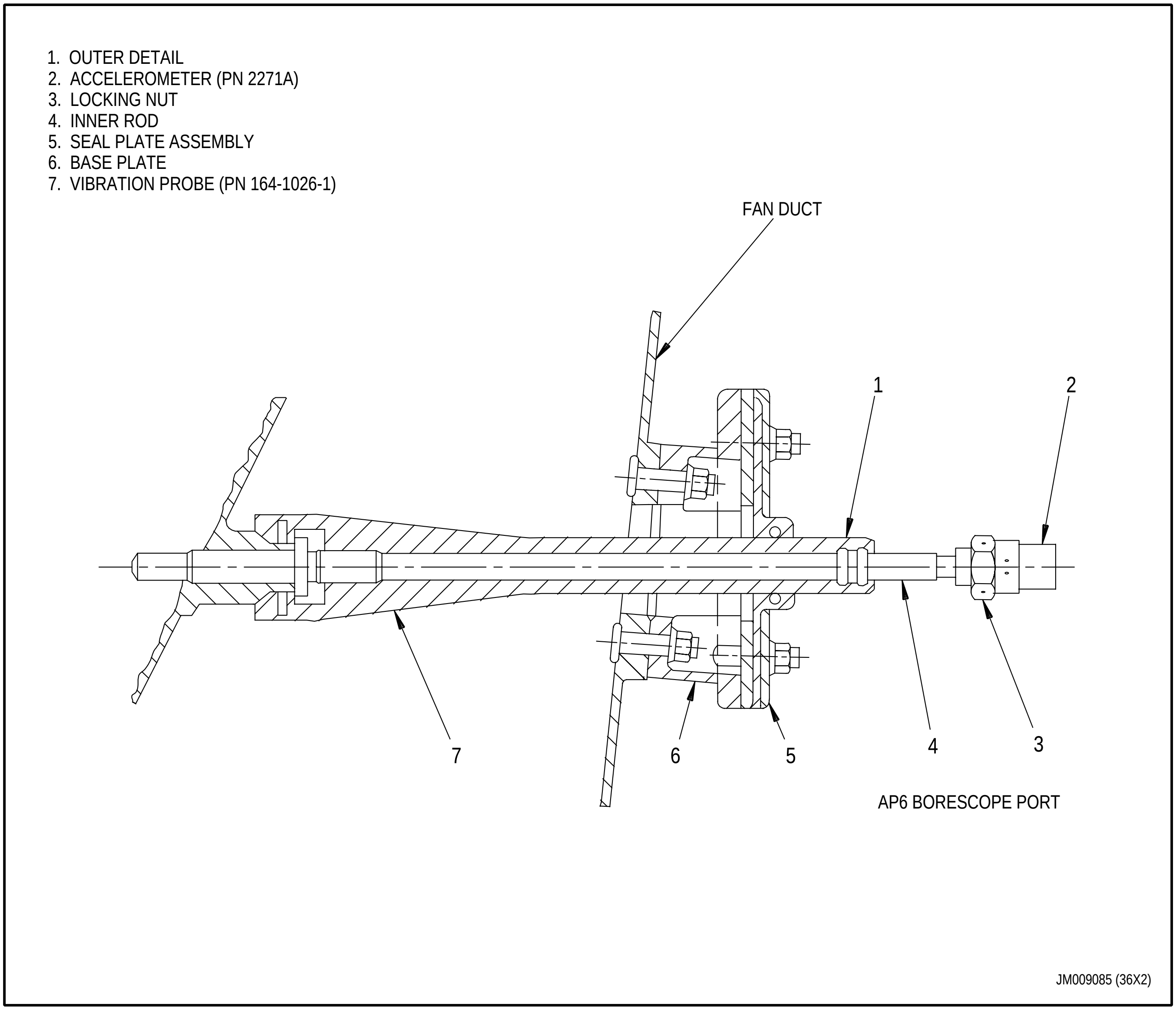


Figure 7. AP6 Vibration Plug and Accelerometer - Installation

(g) Insert vibration probe(7) into core and lock bayonet plug of outer detail(1) onto core boss by turning outer detail 1/4 turn counterclockwise.

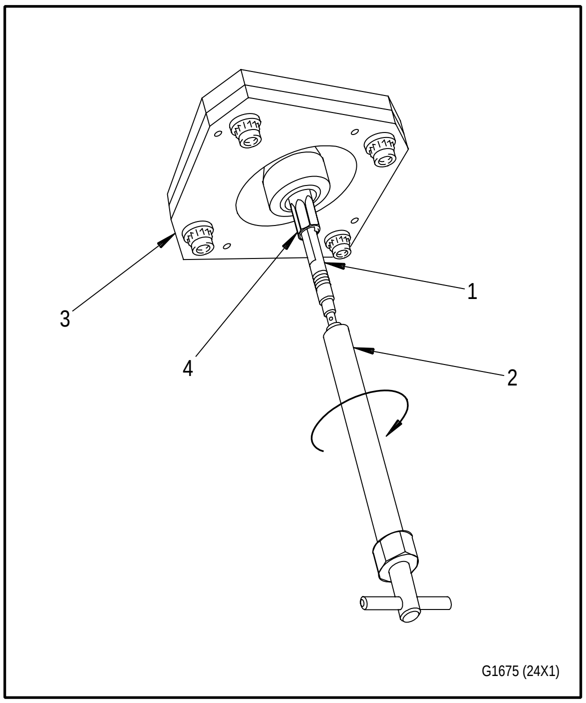
(h) Tighten inner rod detail(1, figure 8) while holding outer rod(4) using PN 103-2092-1 wrench(2). Torque inner rod detail(1) 30 to 40 pound-inches.

(i) Install base plate(6, figure 7) of seal with "FRONT" mark toward front of engine onto fan duct port boss studs. Torque nuts 23 to 26 pound-inches.

(j) Install seal plate assembly(5) to base plate(6) of seal assembly using detail bolts. Torque bolts 55 to 61 pound-inches.

(k) Install locking nut(3) onto inner rod(4) exposing approximately three threads.

(l) Install PN2271A accelerometer(2) on vibration probe inner rod(4). Torque locking nut(3) to accelerometer(2) 16 to 20 pound-inches.



1. Inner rod detail
2. PN 103-2092-1 wrench
3. Seal assembly
4. Outer rod

Figure 8. PN 103-2092-1B Wrench - Application

c. Install PN 103-2052-1 MOT/Popd probe as follows:

(1) Remove lockwire and PN MS9902-08 plug from main oil pump discharge pressure manifold boss, located just forward of main oil pressure transmitter (typical PN 4059195) (See figure 9.).

CAUTION

Use only MIL-L-7808 oil or VV-P-236 petrolatum to lubricate preformed packing.

(2) Lubricate packing with light coat of MIL-L-7808 oil or VV-P-236 petrolatum.

NOTE

Ensure preformed packing remains on unthreaded portion of probe during installation.

(3) Install preformed packing on probe; then install PN 103-2052-1 probe in manifold boss.

(4) Torque locknut, while holding hex of probe, 200 to 225 pound-inches.

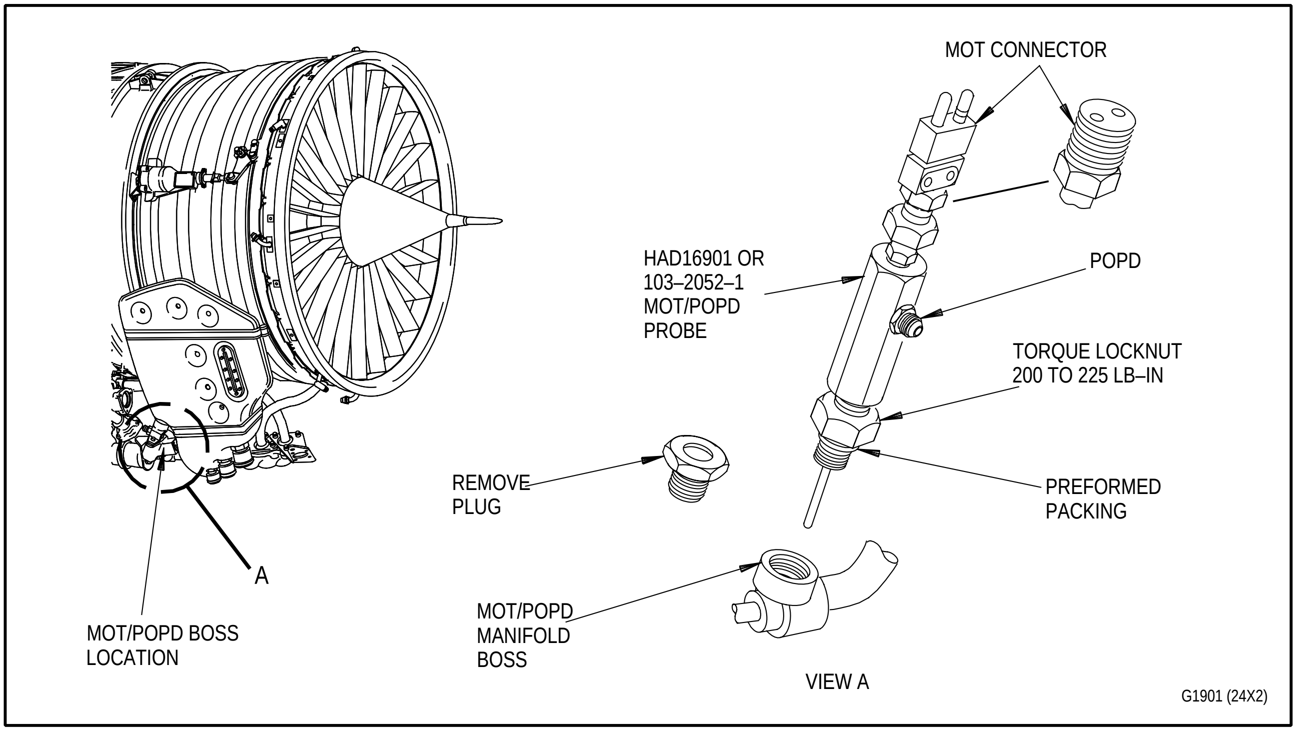


Figure 9. MOT/POPD Probe - Installation

d. Install PN 103-2081-1 nozzle band assembly as follows:

NOTE

Location of band assembly around augmentor should be such that rubber pads lie at least partially on larger spaces between rows of spotweld marks.

(1) Position nozzle band assembly on nozzle support case.

(2) Locate nozzle band latch and strike ends at approximately 3 o’clock position.

(3) Adjust band assembly along nozzle length until forward edge of wider bandis approximately 2 1/2 inches from nozzle forward flange. (See figure 10.)

CAUTION

Excessive tension may result in damage to augmentor nozzle skin.

NOTE

Tension on band assembly may be adjusted by adjusting length of drawbar.

(4) To initially stretch and settle band assembly around nozzle, it may be necessary to extend latch drawbars to allow engagement with strikes. Readjust drawbars to obtain proper tension, engage with strikes, and close handle to lock. Install safety pins.

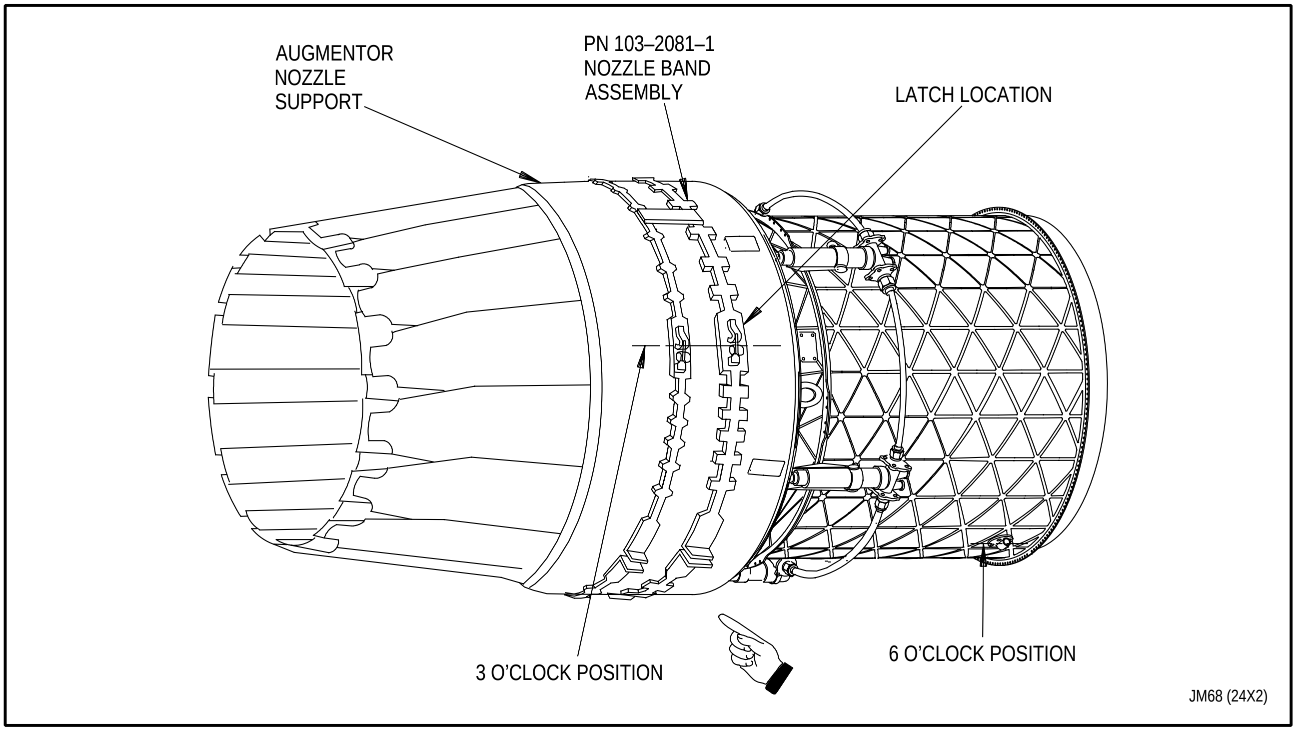


Figure 10. PN 103-2081-1 Augmentor Nozzle Band - Installation

e. Install fuel inlet adapter as follows (See figure 11.):

(1) If main fuel pump cover is installed, remove nuts and bolts securing cover. Remove cover and discard packing (Sheet 1).

(2) If main fuel pump plug is installed, turn handle counterclockwise and remove plug (Sheet 1).

CAUTION

Use MIL-L-7808 oil or VV-P-236 petrolatum only to lubricate preformed packing.

NOTE

Ensure main fuel pump cover is installed on side opposite fuel supply coupling assembly.

(3) Lubricate new PN MS9967-235 preformed packing with MIL-L-7808 oil or VV-P-236 petrolatum. Install packing in groove of fuel inlet adapter.

(4) Install fuel inlet adapter on main fuel pump supply port using bolts, and washers. Torque nuts 85 to 95 pound-inches (Sheet 2).

f. Clean RCVV shaft to prevent shaft seal leakage as follows:

NOTE

Ensure Rcvv actuator shaft is fully extened. (See figure 10A.)

(1) Extend RCVV actuator shaft. Refer to T.O. 2J-F100-56-4, WP 101 00.

(2) Using clean lint-free cloth, remove shaft deposits by rubbing complete shaft until entire area is clean. (See figure 10A.)

(3) If required, remove deposits from shaft by rubbing with clean lint-free cloth moistened with MIL-C-87937 type I cleaning compound. (See figure 10A.)

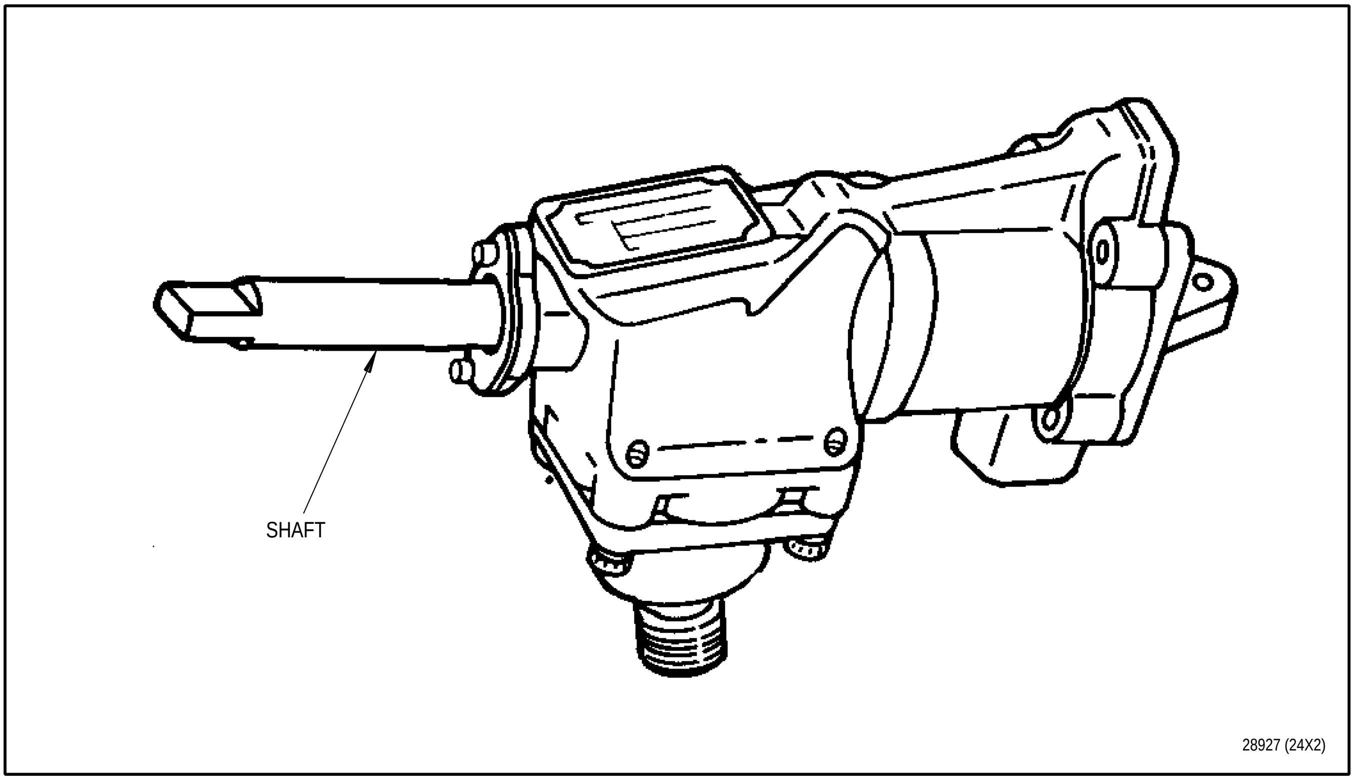


Figure 10A. Rear Compressor Variable Vane Linear Actuating Cylinder Shaft - Cleaning

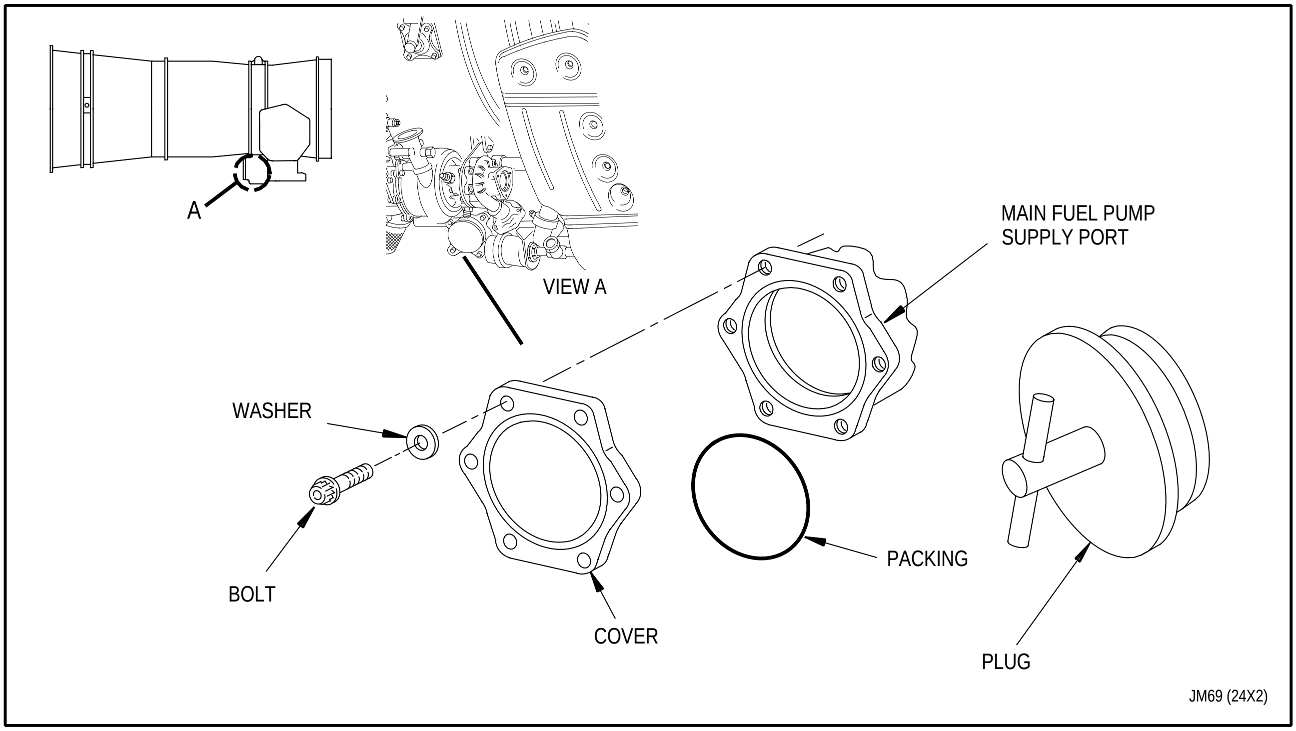


Figure 11. Fuel Inlet Adapter - Installation (Sheet 1 of 2)

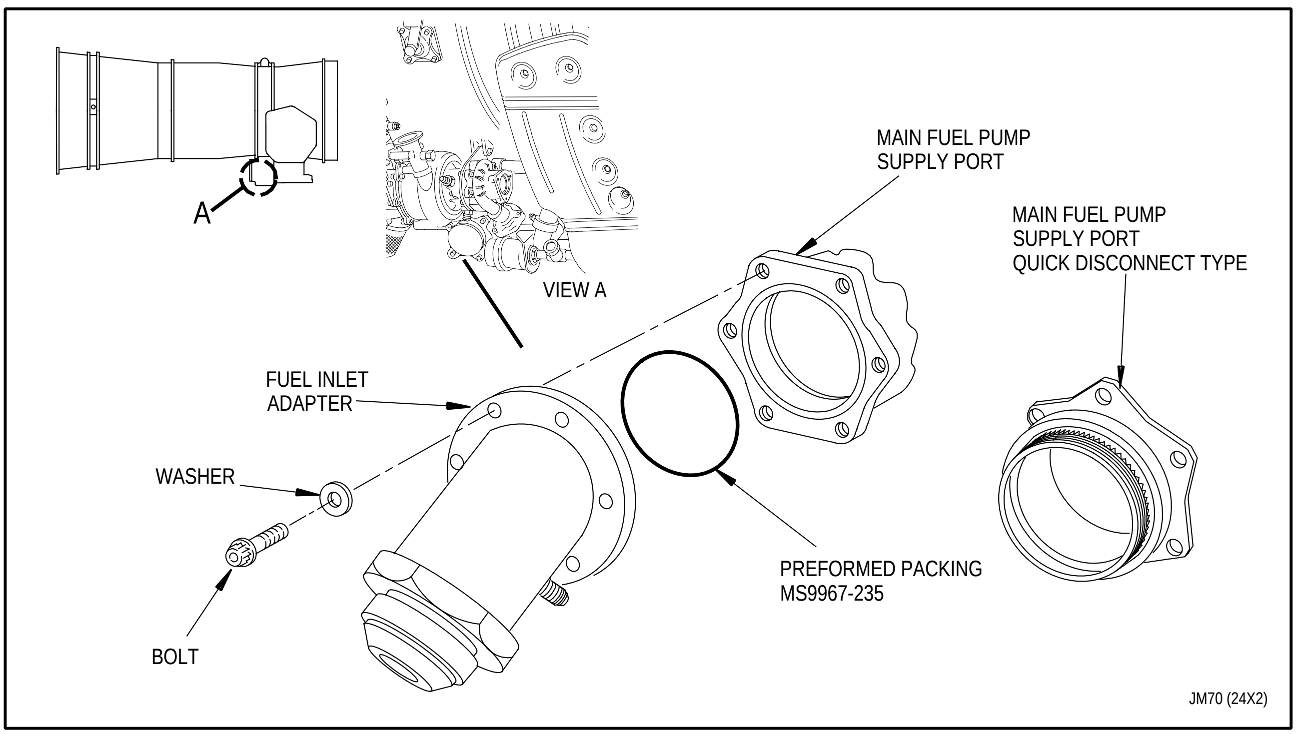


Figure 11. Fuel Inlet Adapter - Installation (Sheet 2 of 2)

WORK PACKAGE

TECHNICAL PROCEDURES

FINAL ENGINE DRESS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Oil System Contamination	WP 304 00
Engine Fuel System Contamination	WP 305 00
Engine Troubleshooting - General	WP 501 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection - Equipment and Operation	WP 020 00
Engine Test Starter Drive Assembly	T.O. 33D4-6-553-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function -Tool Nomenclature	Tool Number
3	Engine Final Dress Procedures	
	Plate, Blank-Off, Anti-Icing - - - - - - - - - - - - - -	LM 1004

ILLUSTRATED SUPPORT EQUIPMENT

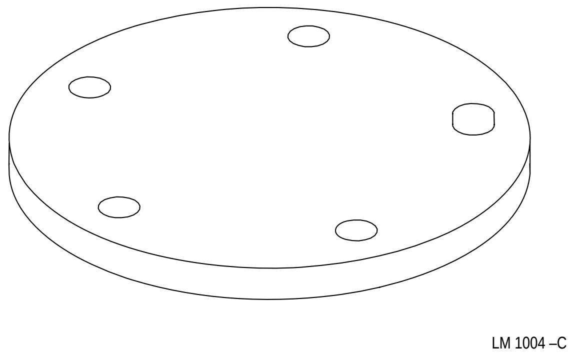


Figure T1. LM 1004 Blank-Off Plate

1. INTRODUCTION.

This work package contains final engine dress instructions.

2. PRELIMINARY INSTRUCTIONS.

Accomplish procedures in following work packages before performing final engine dress:

• Engine transfer from shipping support to AF 8624150 test cell adapter	T.O. 2J-F100-11-2	WP 004 00
• Preliminary engine dress	T.O. 2J-F100-11-2	WP 005 00

3. ENGINE FINAL DRESS PROCEDURES.

(See Figures 1 through 4.)

WARNING

Take care not to strike Ps2 probe. Striking probe can cause personal injury.

CAUTION

Failure to properly support and secure cables/hoses may result in equipment failure and engine damage.

NOTE

Nylon cable ties and braided nylon cord may be used to secure or support cables/hoses to test stand structures or to cool parts of engine.

a. Secure all cables, hoses, etc. to prevent movement during engine test. Use conduit, nylon cable ties, or braided nylon cord. Support from overhead structure to prevent undue strain on connector backshells.

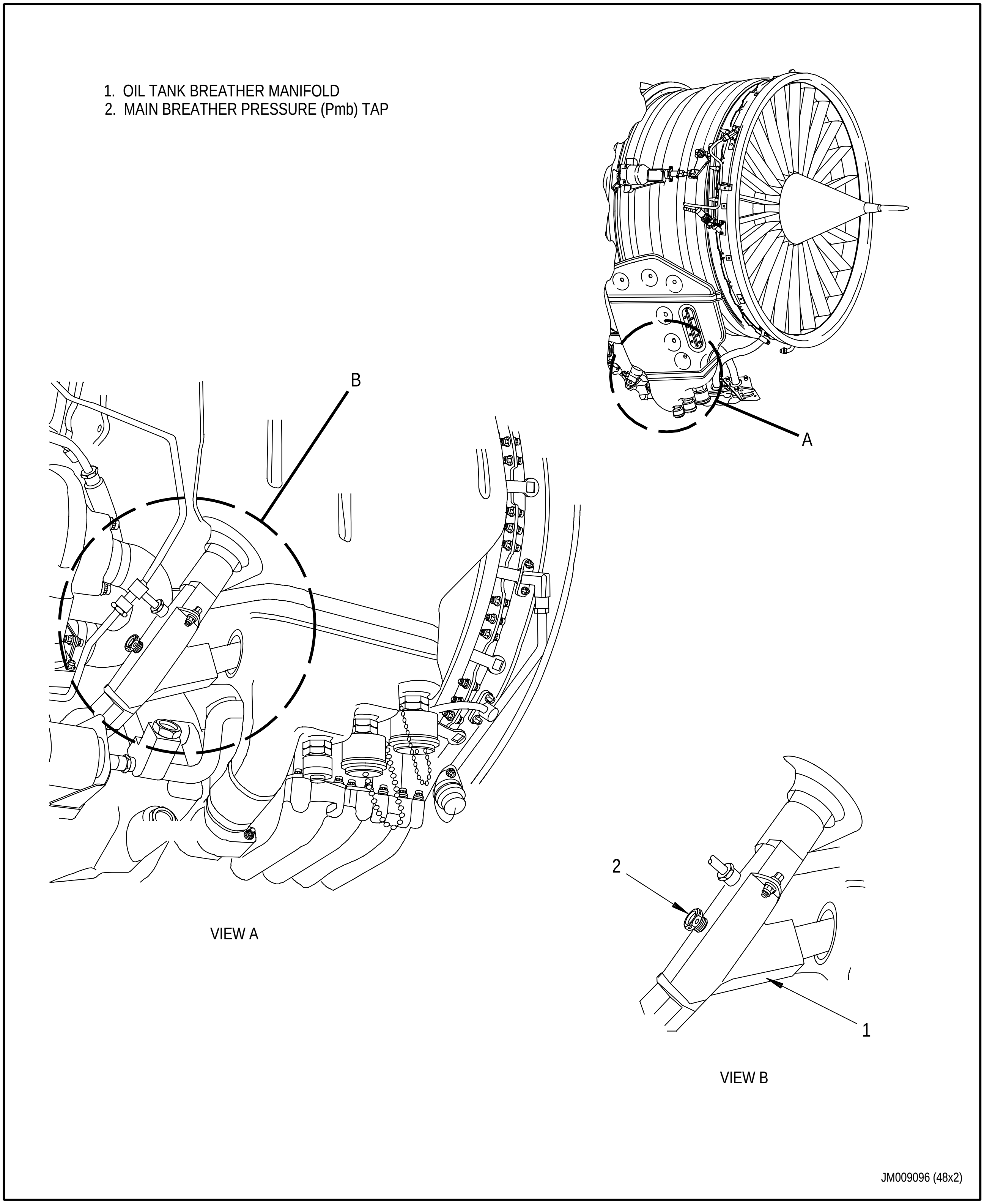


Figure 1. Main Breather Pressure (Pmb) Tap - Location

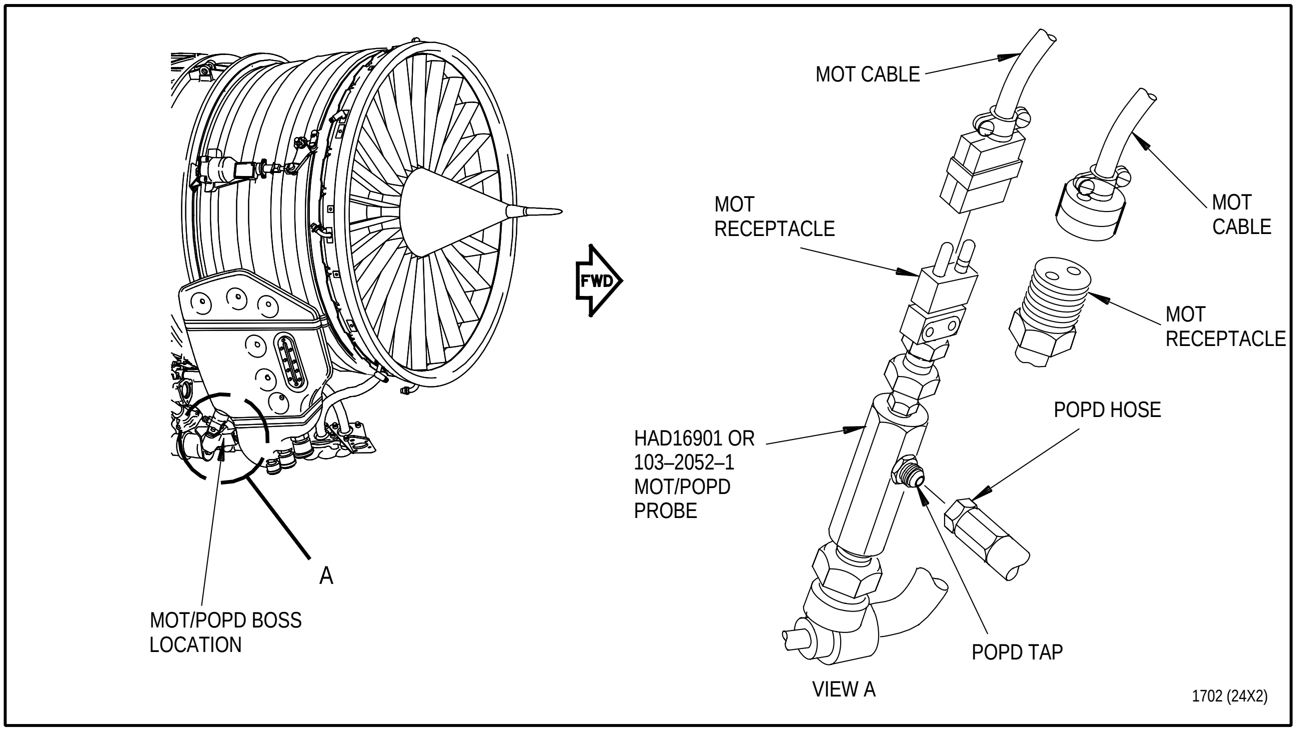


Figure 2. Hose And Cable Connections to MOT/POPD Probe

b. Remove Pmb cap(2, figure 1) at oil tank breather manifold(1). Connect Pmb pressure hose to Pmb tap.

c. Connect Popd hose to MOT/Popd probe. (See figure 2.)

d. Connect MOT cable to MOT receptacle on MOT/Popd probe.

e. Connect EMSE to DEEC and EDU as follows:

(1) Connect P146 connector to J146 engine receptacle.

(2) Connect P20 connector to J1 receptacle on EDU.

(3) Connect P21 connector to J2 receptacle on EDU.

(4) Connect P22 connector to J3 receptacle on EDU.

CAUTION

Ensure ignition cables are secured away from starter jaw to avoid entanglement.

f. Disconnect engine ignition cable P119 connector from generator stator. Connect P119A connector to J119 receptacle and J119A connector to P119 connector of engine ignition cable.

g. Connect adapter assemblies of overboard drain adapters to engine fuel drains OD 1 and OD 2.

h. Connect fuel supply line to main fuel pump coupling as follows: (See figure 3.)

(1) If test stand has quick disconnect (QD) fuel supply line, connect main fuel supply hose coupling to QD coupling half on main fuel pump.

(2) If test stand does not have QD fuel supply line, connect fuel supply hose to MFP fuel coupling.

(3) Connect bleed hose to fuel inlet adapter.

NOTE

DEEC fault clearing cannot be accomplished with W82 extension cable connected.

i. Clear DEEC using EMSE. Refer to WP 656 00. Do not use W82 extension cable.

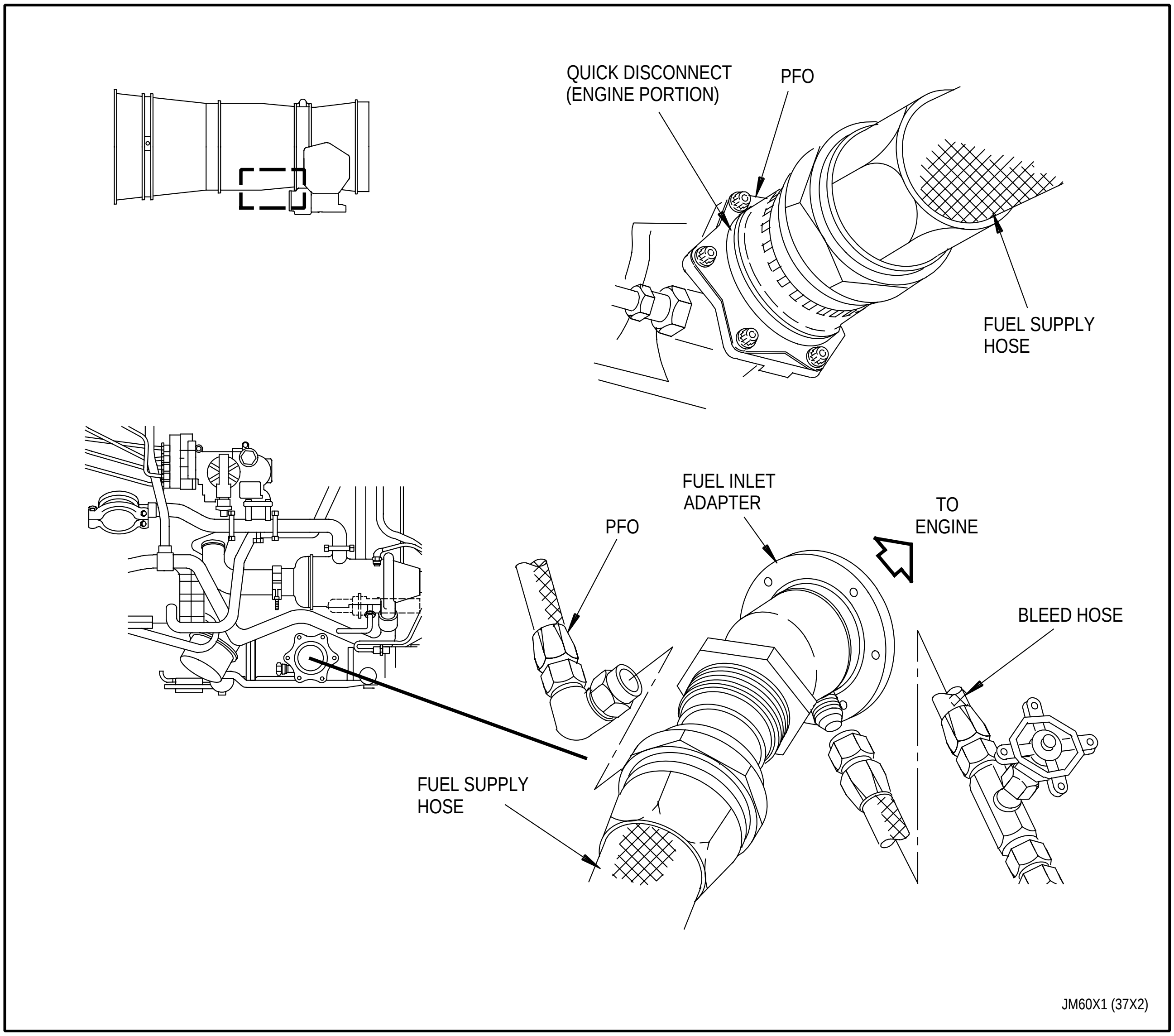


Figure 3. Fuel Supply and Bleed Hoses - Installation

NOTE

Ensure cooling switch is in proper position.

j. Ensure DEEC/EDU cooling switch in correct position as follows:

(1) For F-15C and F15D place switch in F-15 position.

(2) For F15E and F16 place switch in F16 position.

k. Connect DEEC/EDU cooling lines by connecting fuel tank fuel input line to engine quick-disconnect couplings located near main fuel pump filter.

l. Install anti-chuck arm by positioning rod end eye in slot at engine mount EM3 (between Flange H and J at 5 o'clock position). Secure rod to engine mount with quick-release pin.

m. Position anti-chuck arm on test cell adapter and secure with quick-release pins.

n. Check inlet screen for cracks, loose, or damaged probes. Check inlet for FOD.

NOTE

Ensure PWA 56057 adapter is installed on bellmouth assembly/bellmouth extension assembly.

o. Mate bellmouth assembly/ bellmouth extension assembly to engine.

CAUTION

Improper alignment of starter jaw to gearbox shaft coupling jaw can overstress the coupling.

p. Ensure alignment of starter jaw to starter jaw coupling.

CAUTION

Failure to lubricate starter gearbox needle bearings or to service starter gearbox before every engine test will cause starter gearbox failure.

q. Daily inspection and servicing of PN 103-3018-1 starter gearbox is mandatory. If previously accomplished, go to step r., otherwise inspect and service starter gearbox as follows:

(1) Check oil level indicated on oil level sight gage (located on lower rear side of starter gearbox housing).

(2) If gearbox oil servicing is required, remove pipe plug (located at 12 o’clock position on gearbox housing) and oil service gearbox as required. Refer to T.O. 33D4-6-553-1.

(3) Lubricate needle bearings at air cylinder-gearbox interface daily.

r. Secure throttle shaft to engine main fuel control power lever shaft and throttle gearbox.

CAUTION

Failure to properly support and secure cables/hoses may result in equipment failure and engine damage.

NOTE

Nylon cable ties and braided nylon cord may be used to secure or support cables/hoses to test stand structures or to cool parts of engine.

s. Check all cables/hoses connected to engine for proper support and connection. Cables shall be bundled, secured, and supported to overhead structure to avoid putting weight of cables on cable connectors.

NOTE

If core run-in procedures are to be performed, the anti-ice valve shall be removed and blank off plates installed on air manifold and anti-ice manifold.

t. Fabricate two LM 1004 anti-ice system blank-off plates

u. Install LM 1004 anti-ice system anti-ice. blank-off plates as follows (See figure 4):

(1) Remove P149 and P150 connectors from anti-ice valve. Secure connectors to RCVV resolver cable using tie straps during engine operation.

(2) Remove bolts and nuts from anti-ice valve disconnecting it from air supply manifold at both ends.

(3) Remove anti-ice valve and store for reinstallation.

CAUTION

To prevent engine damage, ensure link assembly is properly connected to air supply manifold.

(4) Install two bolts and nuts through link assembly, air supply manifold and LM 1004 anti-ice system blank-off plate. Install remaining three bolts and nuts. Torque nuts 62 to 72 pound-inches.

(5) Install LM 1004 anti-ice system blank-off plates on air outlet side manifold using bolts and nuts. Torque nuts 62 to 72 pound-inches.

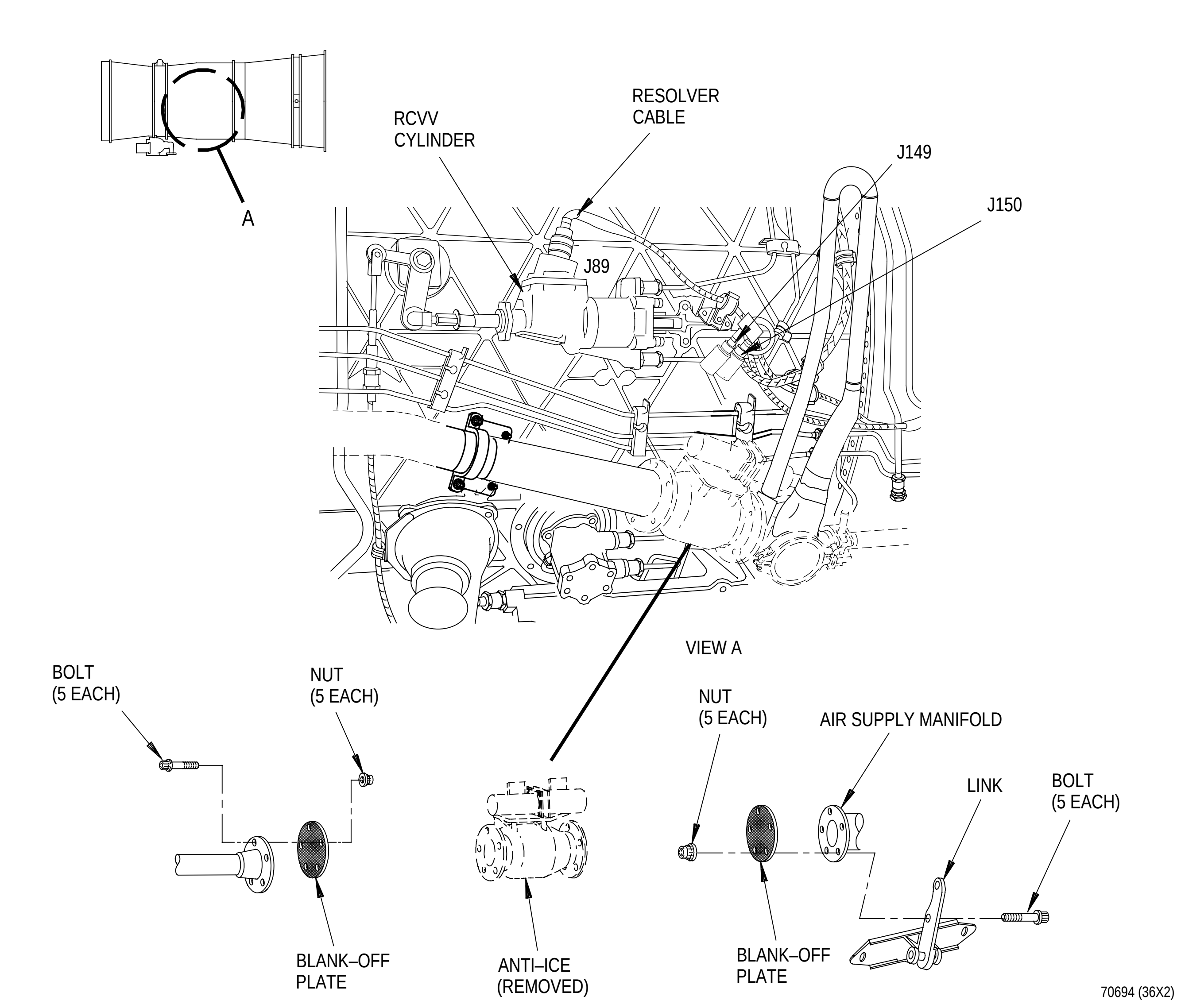


Figure 4. Anti-ice System Blank-off Plates - Installation

WORK PACKAGE

INTRODUCTION

ENGINE PRETEST PROCEDURES
ALPHABETICAL INDEX

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 2

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	0				

1. INTRODUCTION.

This work package introduces the 100 00 through 199 00 series of work packages for engine pretest procedures. The following work packages are included in this series:

WP No.	Title
101 00	Engine and AF 8624150 Test Cell Adapter Installation Into AF 8624151 Thrust Frame
102 00	Engine Final Dress (After Installation Into AF 8624151 Thrust Frame)
103 00 through 107 00	Open
108 00	Engine Depreserving
109 00	Engine Oil Servicing Procedure
110 00	Engine Motoring
111 00 through 199 00	Open

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE AND AF 8624150 TEST CELL ADAPTER INSTALLATION INTO AF 8624151 THRUST FRAME

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	0				
6 Blank	0				

REFERENCE MATERIAL REQUIRED

None

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains instructions for engine and test cell adapter installation into AF 8624151 thrust frame.

2. ENGINE AND TEST CELL ADAPTER INSTALLATION INTO AF 8624151 THRUST FRAME.

(See Figures 1 and 2.)

CAUTION

Engine and adapter shall be raised to full up position to ensure clearance of cone bolts on thrust frame and sockets on adapter.

a. Slowly raise front and rear hoists together and lift engine and adapter to full up position from adapter storage support.

CAUTION

Ensure monorail path is clear for transport of engine and adapter into test cell.

NOTE

Ensure monorail ‘‘Y’’ switch is set to proper test cell rail spur.

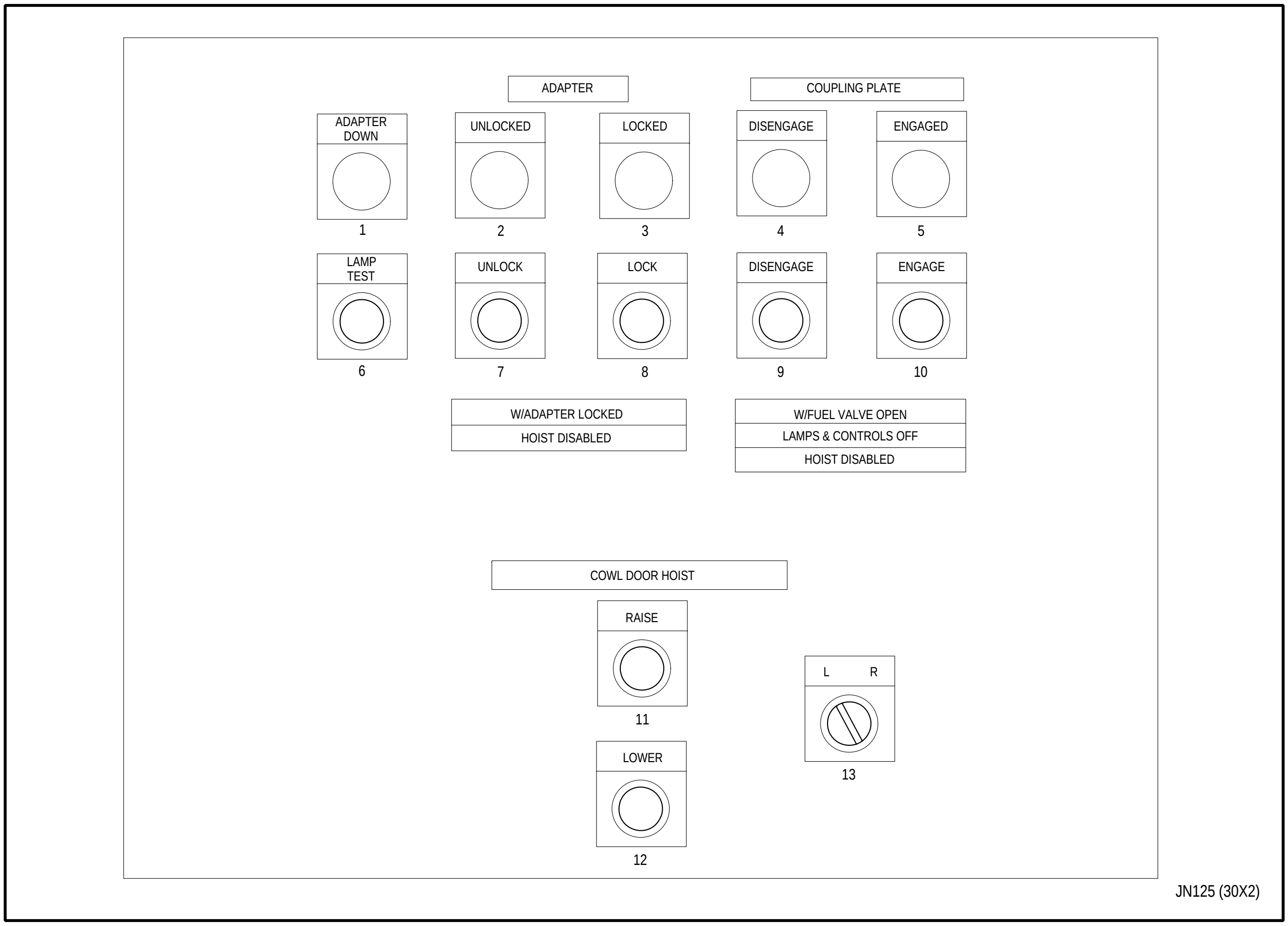
b. Transport engine and adapter to available test cell.

c. Slowly lower engine adapter onto thrust frame cone bolts.

d. Turn hoist pendant off.

e. Engage thrust frame adapter locks(8, figure 1), adapter LOCKED(3) panel light illuminates.

f. Engage thrust frame coupling plate(10), coupling plate ENGAGED(5) panel light illuminates.



1. ADAPTER DOWN indicator
2. Adapter UNLOCKED indicator
3. Adapter LOCKED indicator
4. Coupling plate DISENGAGE indicator
5. Coupling plate ENGAGED indicator
6. LAMP TEST push button switch
7. Adapter UNLOCK push button switch
8. Adapter LOCK push button switch
9. Coupling plate DISENGAGE push button switch
10. Coupling plate ENGAGE push button switch
11. Cowl door hoist RAISE push button switch
12. Cowl door hoist LOWER push button switch
13. L R (left/right) switch

Figure 1. Thrust Stand - Control Panel

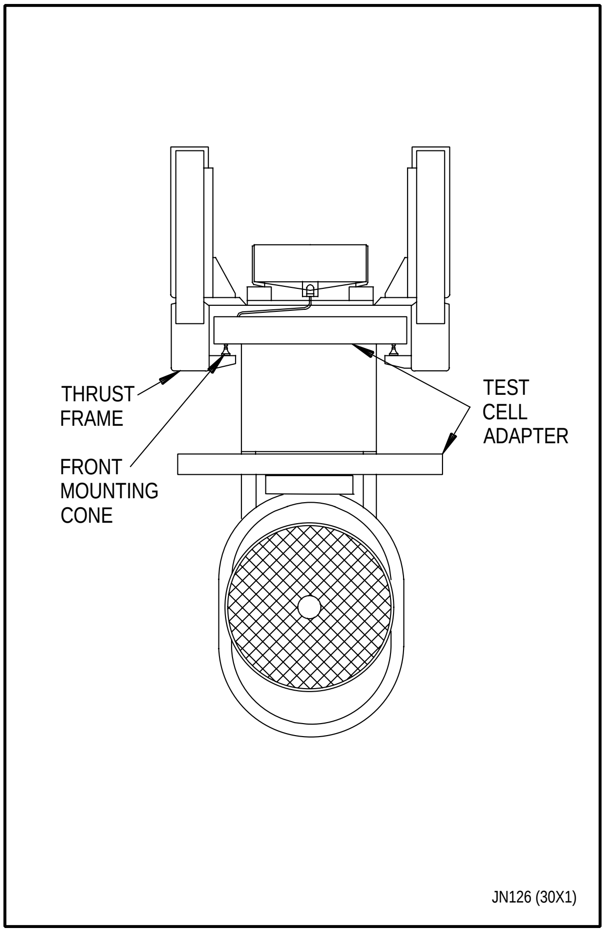


Figure 2. Engine Installation Into Thrust Frame

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE FINAL DRESS (AFTER INSTALLATION INTO AF 8624151 THRUST FRAME)

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	0				
6 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains:

- Engine final dress procedures
- Power lever installation and rigging

2. PRELIMINARY INSTRUCTIONS.

a. The following work packages shall be performed before engine final dress (after installation into AF 8624151 thrust frame):

• Engine transfer from shipping support to AF 8624150 test cell adapter	WP 004 00
• Preliminary engine dress	WP 005 00
• Final engine dress	WP 006 00
• Engine and AF 8624150 test cell adapter installation into AF 8624151 thrust frame	WP 101 00

3. ENGINE FINAL DRESS PROCEDURES (AFTER INSTALLATION INTO AF 8624151 THRUST FRAME).

a. Place DEEC/EDU cooling switch at fuel tank in proper position:

- For F-15C and F-15D, position is F-15.
- For F15-E and F-16, position is F-16.

b. Connect DEEC/EDU cooling lines by connecting fuel tank input line to engine quick-disconnect couplings located near main fuel filter.

c. Install overboard drain canister on gearbox, OD-1, and OD-2 drain collectors as follows:

(1) Ensure preformed packing in body of drain canister is serviceable. If not, replace with serviceable packing.

(2) Position body of drain canister against drain collector.

(3) Secure body of drain collector to body of drain canister.

NOTE

Vibration transducer and cable installations are only required for engines requiring acceptance test or vibration monitoring per WP 212 00.

d. Connect vibration cables as follows:

CAUTION

- Do not bend special purpose electrical cable less than five inches radius. Inner conductors or outer wire braid may be damaged if cable is bent in smaller radius.
- Failure to properly route vibration cable to inlet case accelerometer can result in engine ingestion of cable and extensive engine damage. Adjust accelerometer so terminal points to rear of engine.

(1) Connect cable between each accelerometer (VICV, VGBV, VDCH and VAP6) and vibration channel on connector panel or EETP. Route inlet case accelerometer cable rearward of bellmouth inlet seal. Remove excess slack from cables.

e. Mate air starter and engine gearbox starter jaw coupling as follows:

(1) Position ENGINE START engage switch to ON, to fully extend starter jaw.

(2) Ensure starter jaw teeth are engaged.

(3) Position ENGINE START switch to OFF to retract drive assembly starter jaw.

(4) Check for minimum disengaged clearance of 5/8 inch between air starter jaw and engine gearbox starter jaw coupling.

f. Check all wires, hoses, cables, etc. to ensure they are properly secured and supported. Securing may be accomplished using conduit, wire ties, and/or clamps.

4. THROTTLE CONNECTION AND RIGGING.

a. Ensure test cell PLA and MFC PLA correspond as follows:

(1) CUT-OFF Position: With test cell throttle at CUT-OFF and indicating zero degrees PLA, MFC power lever shaft should contact OFF stop.

(2) IDLE Position: With test cell throttle set at IDLE and indicating 16.5 degrees PLA.

(3) Intermediate (MIL) Position: With test cell throttle at Intermediate (MIL) and indicating 86 degrees PLA.

(4) MAXIMUM Position: With test cell throttle set at MAXIMUM and indicating 130 degrees PLA, MFC power lever shaft should contact MAX stop.

(5) Following initial throttle rigging per step a., cycle throttle through full range several times, checking for binding between test cell throttle and MFC power lever shaft. System should operate smoothly.

(6) Check throttle for repeatability.

(7) Move throttle to CUT-OFF.

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE DEPRESERVING

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Oil System Servicing	WP 109 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
Lockwire (0.032 inch diameter)	MS9226-04
Lockwire (0.040 inch diameter)	MS9226-05
Oil, lubricating	MIL-L-7808 or
Petrolatum (alternate to oil)	VV-P-236

EXPENDABLE ITEMS

Nomenclature	Part Number	Quantity
Packing, preformed	ST1001-10	1
Packing, preformed	ST1051-10	1

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
1	Engine Depreservation	
	Cap, drain, lubricating oil tank	PWA 51192

ILLUSTRATED SUPPORT EQUIPMENT

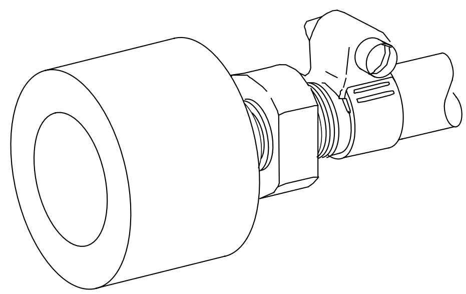


Figure T1. PWA 51192 Cap

1. INTRODUCTION.

a. This work package contains procedures for depreserving an engine.

2. PRELIMINARY INSTRUCTIONS.

a. Dress engine per WP 005 00.

b. Install engine and test cell adapter into thrust stand per WP 101 00.

c. Final dress engine per WP 006 00 and WP 102 00.

3. ENGINE DEPRESERVING.
(See Figure 1.)

CAUTION

- Use only MIL-L-7808 oil or VV-P-236 petrolatum to lubricate preformed packing.
- Ensure drain and sampling valve on oil tank, and combination chip detector and valve on gearbox are properly lockwired. Fittings not properly lockwired can become unscrewed during engine operation, resulting in oil loss and damage to engine bearings.

a. Engine depreserving consists of:

- Draining residual oil from engine oil tank and gearbox and servicing engine oil system.
- Performing engine start to purge the fuel system of preserving fluid.

b. Drain residual oil from gearbox by removing combination chip detector and check valve from right side of gearbox.

(1) Collect residual oil using suitable container.

(2) Lubricate threads of check valve and new PN ST1001-10 packings with light coat of MIL-L-7808 oil or VV-P-236 petrolatum.

(3) Install check valve and packings into gearbox.

(4) Torque 115 to 130 pound-inches.

(5) Lockwire using PN MS9226-04 wire.

c. Drain residual oil from oil tank using one of following two methods: (See figure 1.)

(1) Drain oil through drain and sampling valve as follows:

(a) Remove cover from oil tank drain and sampling valve.

(b) Install PWA 51192 drain cap on oil tank drain and sampling valve.

(c) Allow oil to drain from tank.

(d) Remove PWA 51192 drain cap and install valve cover.

(2) Drain oil by removing drain and sampling valve as follows:

CAUTION

Supporting valve housing boss of oil tank with wrench prevents possible damage to oil tank.

(a) Supporting valve housing boss of oil tank with wrench, remove drain and sampling valve from oil tank, and discard packing.

(b) Allow oil to drain from tank into container.

(c) Lubricate PN ST1051-10 packing and threads of drain and sampling valve with a light coat of MIL-L-7808 oil, or VV-P-236 petrolatum.

(d) Install packing on valve, and install valve in port of lower oil tank boss.

(e) Torque valve 50 to 75 pound-inches.

(f) Lockwire valve with PN MS9226-05 wire.

NOTE

An engine start is required during oil system servicing procedures.

d. Service engine oil system per WP 109 00.

e. Depreserving fuel system is accomplished by starting engine, and since this was performed during oil servicing procedure in previous step, no further action is required on fuel system.

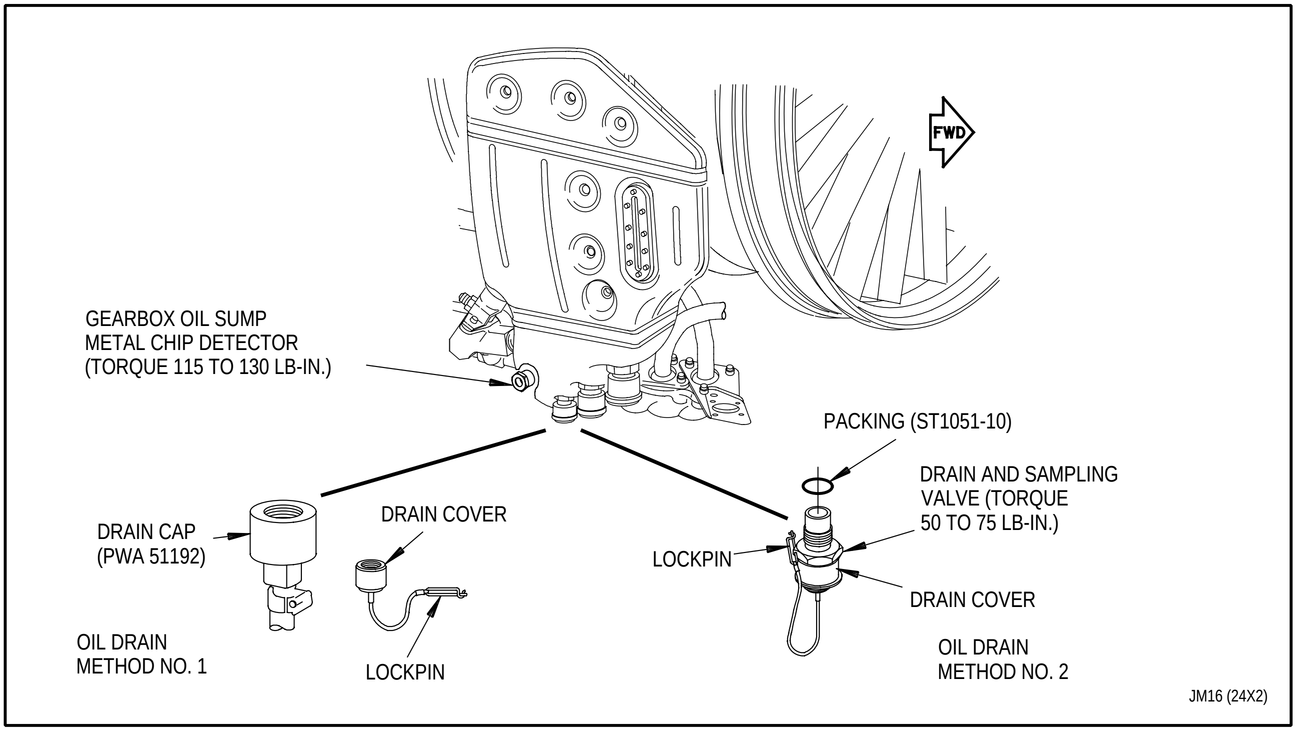


Figure 1. Lubricating Oil Tank Assembly - Draining

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE OIL SYSTEM SERVICING

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 10

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Start Procedures	WP 210 00
Engine Shutdown	WP 225 00
Oil System Contamination	WP 304 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
OIL, LUBRICATING	MIL-L-7808J OR LATER REVISION OR MIL-L-23699C OR LATER REVISION

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
3	Engine Oil System Servicing	
	Tank and Pump Unit	PMU-29/E
	Cap, Lubricating oil tank	PWA 51192

ILLUSTRATED SUPPORT EQUIPMENT

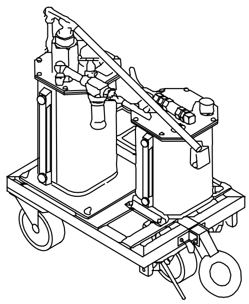


Figure T1. PMU-29/E Pump

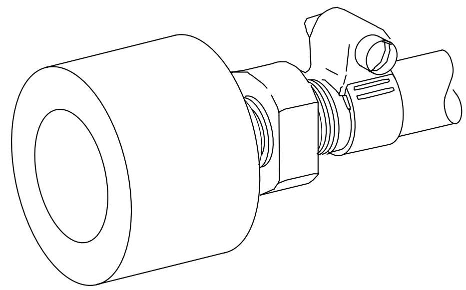


Figure T2. PWA 51192 Cap

1. INTRODUCTION.

a. This work package contains engine oil system servicing procedures.

2. PRELIMINARY INSTRUCTIONS.

a. Perform preliminary engine dress, if required, per WP 005 00.

b. Install engine and test cell adapter into thrust stand per WP 101 00.

c. Perform final engine dress, as required, per WP 006 00 and 102 00.

3. ENGINE OIL SYSTEM SERVICING.
(See Figures 1 and 2.)

CAUTION

- Engine shall not be motored if oil system has not been serviced.
- Failure to service oil system as specified may cause improper servicing, engine oil leaks, and smoke during operation.

NOTE

- This procedure is also applicable for Engine Pretest Oil System Servicing.
- Refer to b. for servicing procedure on engines shutdown less than 30 minutes.
- Refer to c. for servicing procedure on engines shutdown more than 30 minutes.

a. Perform engine oil servicing as follows:

(1) Within 30 minutes of engine shutdown, determine oil quantities added or consumed to nearest half-pint from an oil level reading taken from engine oil tank sight gage scale (graduated in half-pints).

(a) Accurate measurement can be made only when engine oil is heated. Oil level should be determined within 5 to 15 minutes of engine shutdown.

(2) Within 30 minutes of all engine shutdowns, record engine oil levels in test stand log sheet, except where not possible, such as on rebuild engines or engines drained for some other reason.

(3) Ensure engine is not overserviced during filling. Pump servicing cart slowly and keep oil lines connected until all oil flow has visibly stopped in the cart sight glass.

(4) Oil drained from engine shall not be reused for engine oil servicing.

a1. Perform oil servicing for initial fill on new or rebuilt engines (gearbox fully drained) or on engines with unknown service condition as follows: (See figures 1 and 2.)

(1) Remove protective caps from fill and overflow ports on engine oil tank.

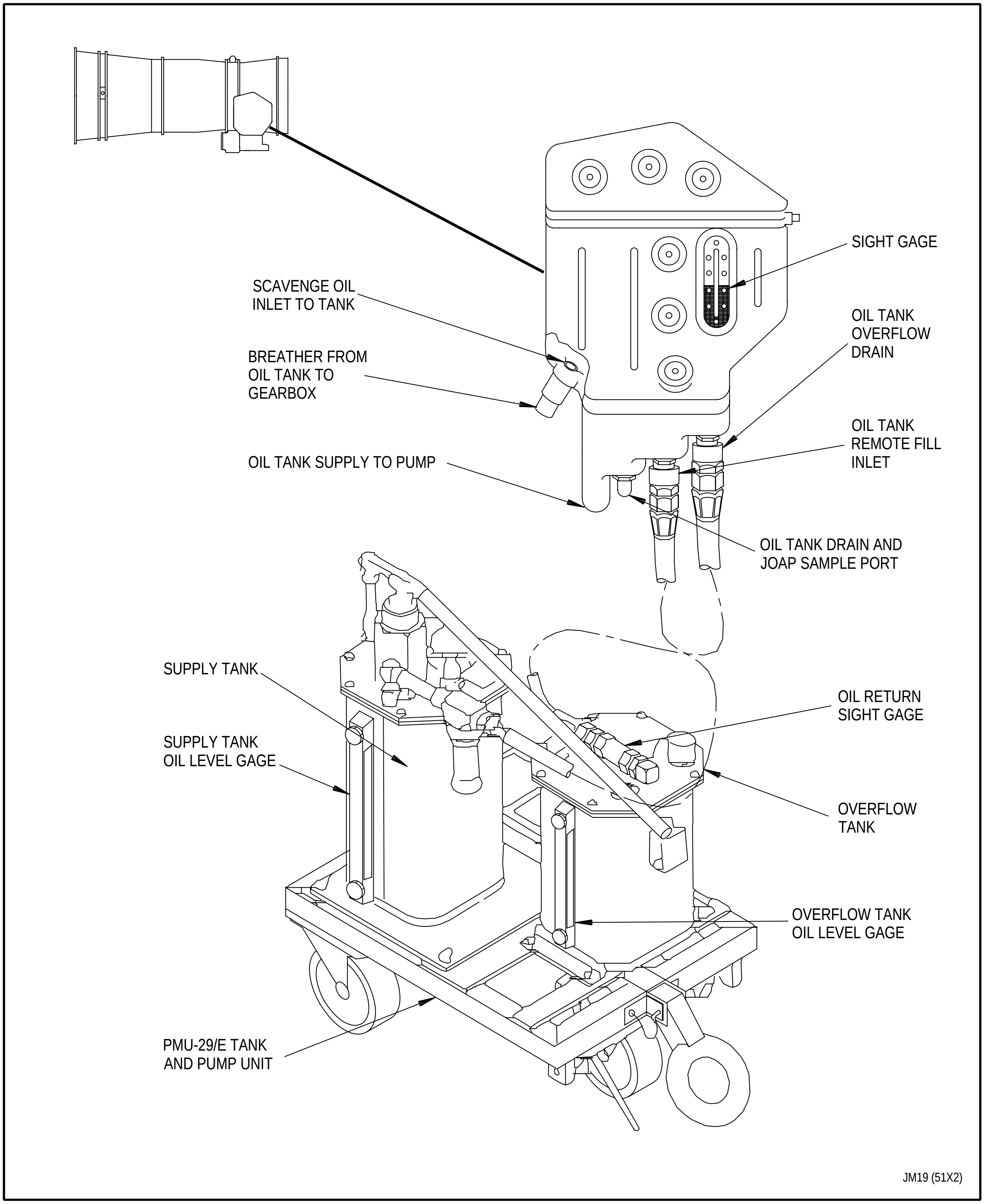


Figure 1. Engine Oil System - Servicing

NOTE

Equivalent pumping equipment shall contain 40 micron filter downstream of pump.

(2) Move PMU 29/E tank and pump unit, or equivalent, into position and place stabilization legs down.

CAUTION

Failure to ensure all connectors are clean and free of foreign matter when connecting tank and pump unit to engine oil tank can result in damage to engine oil system or engine.

(3) Wipe connectors at engine oil tank and at tank and pump unit hoses to ensure no foreign matter will enter oil system.

(4) Connect supply line to inlet port on engine oil tank.

(5) Connect return line to overflow drain port on engine oil tank.

(6) Service oil tank with MIL-L-7808J oil or later revision; or MIL-L-23699C oil or later revision to 36 to 38 half-pints.

(7) Remove return line from oil tank overflow drain port and install protective caps.

(8) Motor engine for 1 minute per WP 110 00.

(9) Check oil tank oil level indication for a level of 36 to 38 half-pints.

(a) If oil level is below 36 half-pints, repeat a.(1) through a.(8).

(b) If oil level is more than 38 half-pints, perform the following:

1 Remove supply line from oil tank inlet port and install protective cap.

2 Place suitable drain pan under engine oil tank.

3 Remove protective cap from engine oil tank JOAP sample port.

4 Install PWA 51192 drain cap and allow oil tank to drain until oil level is between 36 to 38 half-pints.

5 Remove PWA 51192 drain cap and install protective cap onto enigne oil tank.

NOTE

Engines requiring Core Run In:

- Shutdown before completion of core run-in may lead to temporary N_2 rotor seizure.
- Completion of a.(10) will assure adequate oil service without engine run.

(10) If engine requires core run-in, complete the following; otherwise continue to a.(11).

(a) Deleted.

(b) Deleted.

(c) Record oil level in test stand log sheet followed by S to indicate serviced.

(d) Perform core run-in procedures per WP 211 00.

(e) After completion of Core Run In, service oil system per a.(12) through a.(16).

(11) Start engine per WP 210 00. Run engine at IDLE a minimum of 5 minutes to heat oil.

(12) Shut down engine per WP 225 00. Connect servicing cart fill and drain lines to engine oil tank and add or drain oil to 43 to 45 half-pints within 5 to 15 minutes. Disconnect oil lines.

(13) Read oil level within 30 minutes of engine shutdown (to nearest half-pint) using oil tank sight gage scale.

(14) Record this level on test stand log sheet followed by S to indicate serviced.

(15) Record amount of oil required to fill system on test cell log sheet.

(16) Deleted.

b. Oil servicing for engines shutdown less than 30 minutes is as follows: (See figure 2.)

(1) Read oil level in oil tank sight gage scale to nearest half-pint.

(2) Record oil level in test cell log sheet.

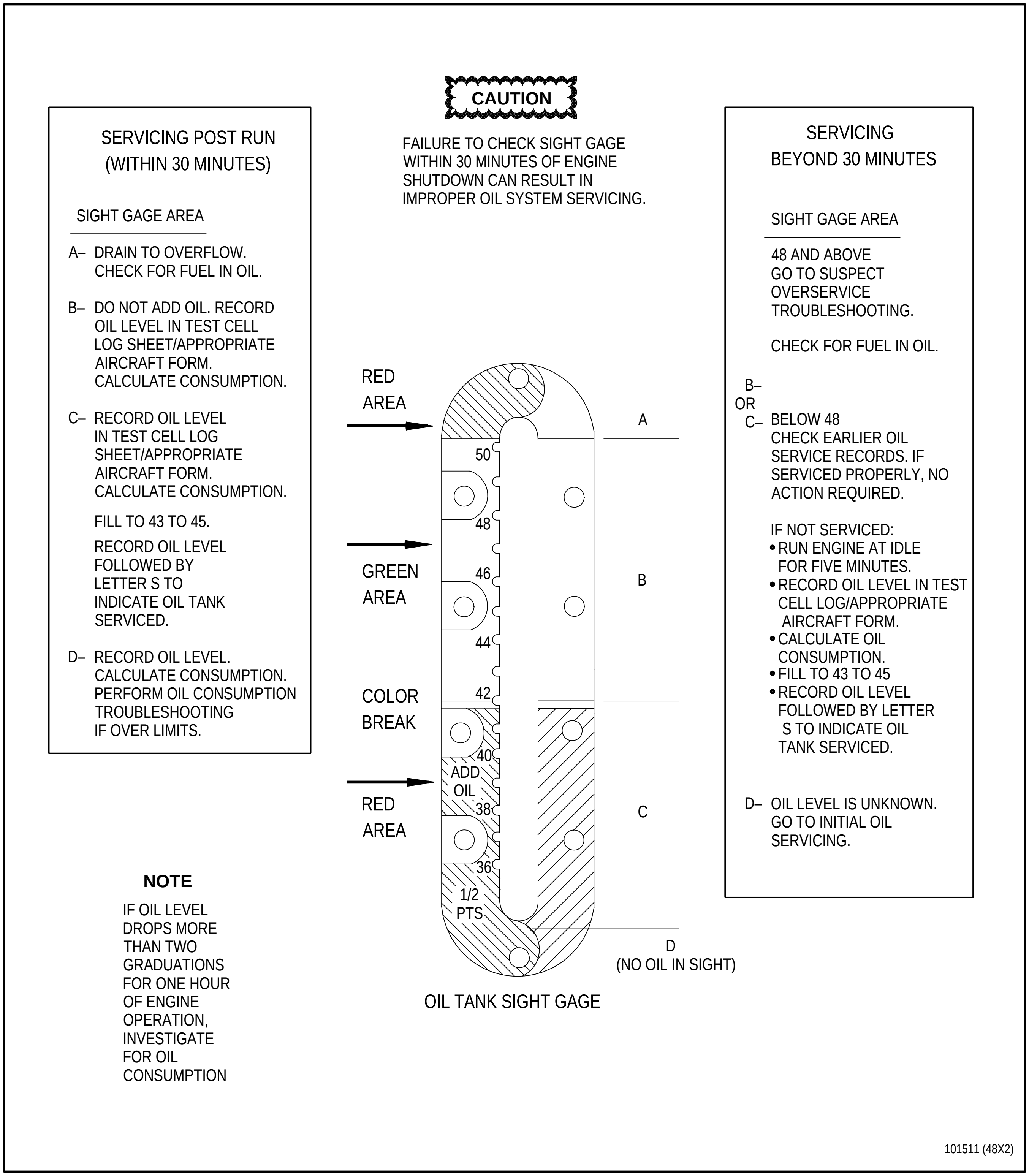


Figure 2. Oil Servicing Guide

(3) If oil level is in Area A, drain to overflow and check for fuel in oil prior to any further engine operation. Refer to oil contamination procedures in WP 304 00. If no fuel in oil, go to Suspect Overservice troubleshooting.

(4) If oil level is in Area B, no action is required. Calculate consumption. Do not add oil.

(5) If oil level is in Area C, calculate consumption, connect servicing cart fill and drain lines to oil tank and add oil to 43 to 45 half-pints.

(6) Record oil level after filling to nearest half-pint in test cell log sheet followed by an S to indicate serviced.

(7) If oil level is not visible on sight gage (Area D), or if oil level has dropped more than two sight gage scale graduations for each hour of engine run time since last service, perform oil consumption check run, per WP 545 00.

c. Oil servicing for engines shut down more than 30 minutes is as follows: (See figure 2.)

(1) Check oil tank sight gage.

(1a) Check servicing records for servicing within 30 minutes of shutdown. If records indicate proper servicing completed and current oil level above 34 half-pints, no servicing is required. Otherwise, go to c.(2).

(2) If oil level is more than 48 half-pints, perform Suspect Overservice troubleshooting per WP 532 00. Check for fuel in oil prior to any further engine operation. Refer to oil contamination procedures in WP 304 00.

(3) Deleted.

(4) If oil level is 34 to 48 half-pints, run engine for 5 minutes, then go to b.

(a) through (l) deleted.

(5) If oil level is not visible in sight gage (Area D), inspect engine for external oil leakage, repair as required. Go to a. for initial servicing to establish proper service level.

(a) through (d) deleted.

d. Deleted.

e. If engine testing is to be performed, go to WP 206 00 for test requirements.

Pages 11 and 12 deleted.

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE MOTORING

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00
Engine Troubleshooting - General	WP 501 00
Engine Test Starter Drive Assembly	T.O. 33D4-6-523-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains instructions for test cell engine motoring.

2. PRELIMINARY INSTRUCTIONS.

a. Perform preliminary engine dress, if required, per WP 005 00.

b. Install engine and test cell adapter into thrust stand per WP 101 00.

c. Perform final engine dress, as required, per WP 006 00 and 102 00.

d. Depreserve engine, if required, per WP 108 00.

e. Service engine oil system, as required, per WP 109 00.

3. ENGINE MOTORING.

(See Table 1.)

CAUTION

Ensure engine oil servicing has been performed before motoring.

NOTE

Engine motoring is performed to fill oil system and ensure there are no fuel or oil leaks.

a. Motor engine per table 1.

b. Check oil tank sight gage. Service engine oil system, if required, per WP 109 00.

c. Perform engine rotation inspection, if required, per WP 225 00.

Table 1. Engine Motoring

Step	Procedure	Result	Corrective Action
1.	Move power lever to CUTOFF.		
2.	Engage FAC FUEL OPEN and CELL FUEL OPEN switches.	Pfo is 10 to 65 psig.	• Adjust test cell fuel pressure control. • Check test cell fuel pump switch wiring and power supply.

NOTE

During motoring, allowable vibration limit is 7.5 mils single amplitude at all accelerometer locations.

Step	Procedure	Result	Corrective Action
3.	Observe following during motoring.		
	a. N2 rpm	Increasing N2 rpm.	Check PTO shaft coupling.
	b. Vibration Levels	Vibrations less than 7.5 mils.	Troubleshoot vibration.
	c. MOP for indication	MOP rises.	Check oil tank for quantity.
	d. Check for leaks	Leakage limits not exceeded.	Repair leaks.
5.	Turn ENGINE START switch on.	ENGINE START light illuminates.	Troubleshoot.

Table 1. Engine Motoring (continued)

Step	Procedure	Result	Corrective Action

CAUTION

If ENGINE START switch has been turned OFF since initial set up, verify starter clutch key engagement before continuing engine start.

Step	Procedure	Result	Corrective Action
6.	Hold START AIR switch on. Start timer for 30 seconds.	1. N2 rpm increases.	• Verify clutch key engagement.
		2. START AIR light illuminates.	• Inspect engine PTO shaft shear coupling. • Perform engine rotation inspection. • Replace or repair starter gearbox or air pressure source.
7.	To discontinue motoring, release START AIR switch.	START AIR light extinguishes.	Check test cell wiring.
8.	Turn ENGINE START switch off.	ENGINE START light extinguishes.	Troubleshoot.
9.	Verify air starter clutch key disengagement.	Clearance between pawls.	

WORK PACKAGE

INTRODUCTION

TESTING PROCEDURES

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

1. INTRODUCTION.

a. This work package introduces the WP 200 00 through 299 00 series of work packages for engine test procedures. The following work packages are included in this series.

b. Values from Engine Monitoring Support Equipment (EMSE) shall be used except where specified when performing data checks.

WP No.	Title
201 00 through 203 00	Open
204 00	General Engine Information
205 00	Engine Operating Limits
206 00	Engine Test Requirements
207 00	Engine Prestart
208 00	Ground Safety Precautions
209 00	Emergency Procedures
210 00	Engine Start Procedures
211 00	Core Run-in
212 00	Engine Acceptance Test
213 00	Acceleration/Deceleration Check
214 00	Primary Mode Functional Check
215 00	Secondary Mode Functional Check
216 00	Idle Functional Check
217 00	Ignition System Functional Check
218 00	Engine Vibration Analysis
219 00 through 224 00	Open
225 00	Engine Shutdown
226 00	Reference Test Data
227 00 through 299 00	Open

WORK PACKAGE

TECHNICAL PROCEDURES

GENERAL ENGINE INFORMATION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 12	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Oil System Contamination	WP 304 00
Engine Fuel System Contamination	WP 305 00
Engine Troubleshooting - General	WP 501 00
Introduction and General Information	T.O. 2J-F100-53-1
On-Condition Maintenance Manual	T.O. 2J-F100-53-2
Engine	T.O. 2J-F100-53-5
Borescope Inspection - Equipment and Operation	WP 020 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains general engine information required for engine testing. The following areas are covered in this work package:

- Directional reference
- Abbreviations
- Thrust definitions
- Power lever settings
- Engine station numbers
- DEEC, MFC, and cable part number sets

2. TROUBLESHOOTING AND DETAILED ENGINE DESCRIPTION.

a. Engine troubleshooting procedures are contained in WP 500 through 600 series. Refer to these work packages for engine malfunctions during testing and additional engine operation information.

b. Engine and system descriptions are contained in T.O. 2J-F100-53-1. Refer to this manual for additional engine operation information.

3. DIRECTIONAL REFERENCES.
(See Figure 1.)

a. In this manual, left, right, clockwise, counterclockwise and other references to engine locations or rotational motions, are as viewed from rear of engine.

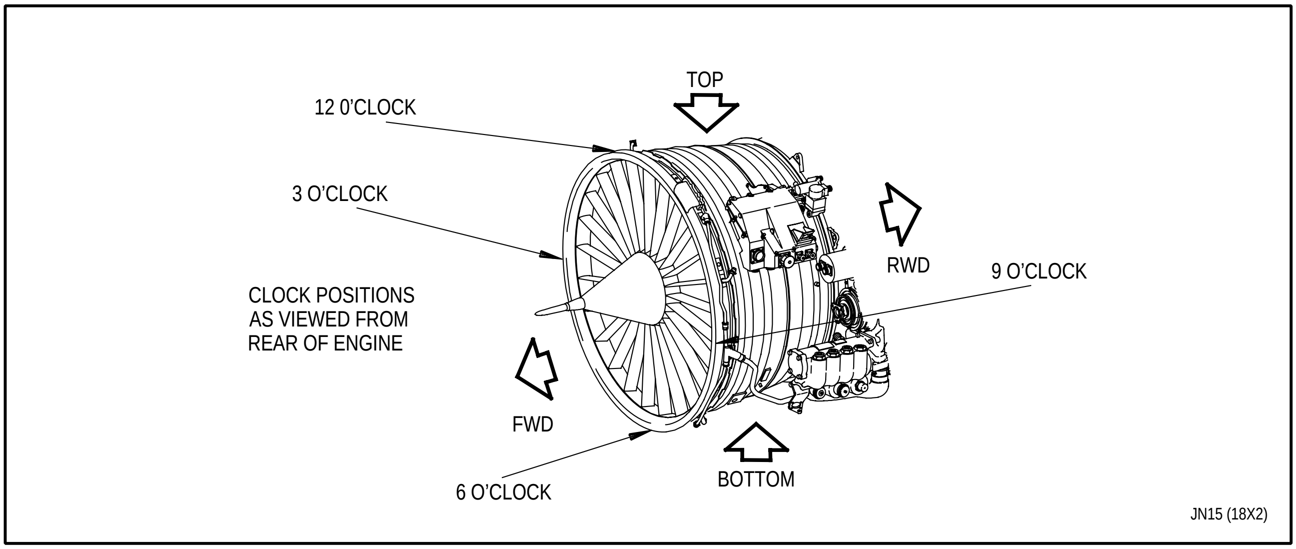


Figure 1. Directional References as Viewed from Rear of Engine (Sheet 1 of 2)

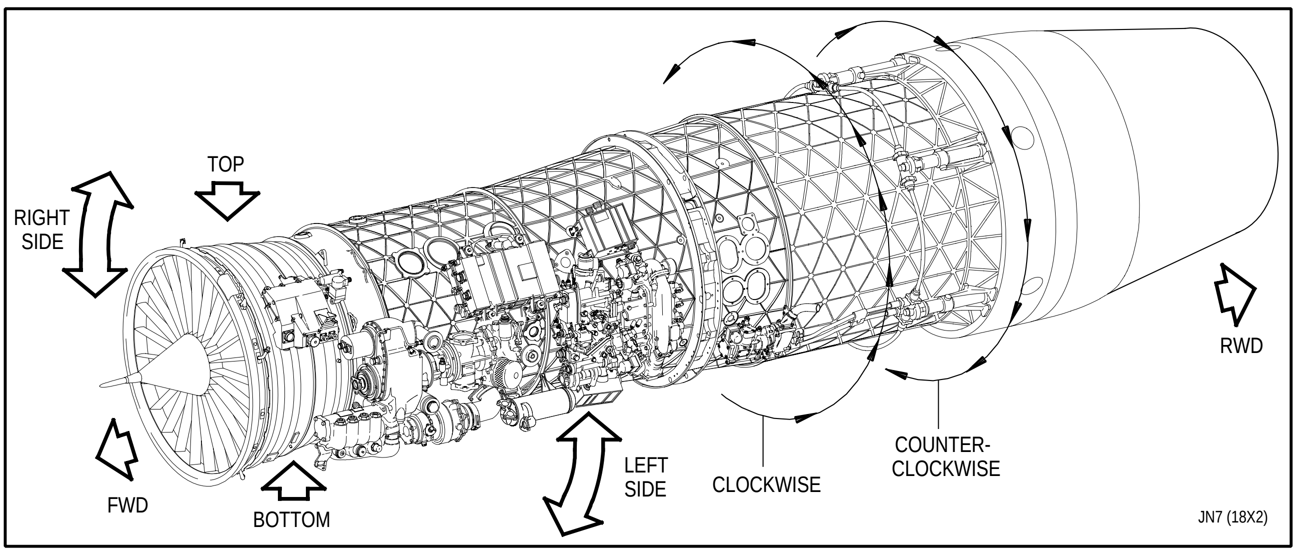


Figure 1. Directional References as Viewed from Rear of Engine (Sheet 2 of 2)

4. ABBREVIATIONS. Some of the abbreviations in this manual are per Military Standard, MIL-STD-12. Those not contained in MIL-STD-12 are:

AFC	-	Augmentor Fuel Control
A_j	-	Augmentor nozzle throat area
AP	-	Borescope inspection ports, AP 1 through AP 7
AUG	-	Augmentor
BPV	-	Breather Pressurizing Valve
BX	-	Bendix Energy Controls Division
CEDS	-	Comprehensive Engine Diagnostic System
CENC	-	Convergent exhaust nozzle control
CIVV	-	Compressor inlet variable vanes
CORR	-	Measured engine parameters corrected to Standard Day Value
DEEC	-	Digital Electronic Engine Control
EAU	-	Engine Analyzer Unit
EDU	-	Engine Diagnostic Unit
EETP	-	Engine electrical terminal panel
EFH	-	Engine flight hours
EHV	-	Electro-hydraulic valve
EMS	-	Engine Monitoring System
EMSE	-	Engine Monitoring Support Equipment
ENP	-	Exhaust nozzle position
ENPT	-	Exhaust nozzle position transmitter
EOT	-	Engine operating time
EPR	-	Engine pressure ratio - P_{t6m}/P_{t2}
ETB	-	Engine trim box
FN	-	Thrust
FTIT	-	Fan turbine inlet temperature ($T_{t4.5}$)
FWD	-	Forward
GG	-	Gas generator (core engine)
GT	-	Greater than
HSD	-	Hamilton Standard Division
HST	-	Hot section time
Hz	-	Hertz (cycles per second)
IAR	-	Idle area reset
IGN	-	Ignition
in. Hg	-	Inches of mercury
in. Hga	-	Inches of mercury, absolute
Intermediate (MIL)	-	Intermediate power (Military)
ISTS	-	Ignition system test set
JOAP	-	Joint oil analysis program
LCF	-	Low cycle fatigue
LOD	-	Light-off Detector, Augmentor
LT	-	Less than

5. ABBREVIATIONS (continued).

MFC	-	Main Fuel Control
MFP	-	Main Fuel Pump
MAX AUG	-	Maximum augmentation; engine power lever in 130 degree position (Segment XI)
MIN AUG	-	Minimum augmentation; engine power lever in 91 degree position (Segment I)
Mn	-	Mach number
MOH	-	Maximum operating hours
MODP	-	Main oil differential pressure (referenced to breather pressure)
MT	-	More than
MOP	-	Main oil pressure
MOPT	-	Main oil pressure transmitter
MOT	-	Main oil temperature
M/V	-	Metering valve
N_1	-	Front compressor rpm
N_1 C_2	-	N_1 corrected to T_{t2}
N_2	-	Rear compressor rpm
N_2 C_2	-	N_2 corrected to T_{t2}
N_2 $C_{2.5}$	-	N_2 corrected to $T_{t2.5}$
P&D	-	Pressurizing and Dump Valve
P_{ab}	-	Augmentor duct pressure
P_{amb}	-	Ambient pressure
P_b	-	Burner pressure
PF	-	Fuel pressure
P_{fo}	-	Fuel pump inlet pressure
PLA	-	Power lever angle; MFC power lever shaft
P_{mb}	-	Main breather pressure
P_{opd}	-	Oil pump discharge pressure
PPH	-	Pounds per hour
P_s	-	Static pressure
P_{s2}	-	Static pressure at fan inlet
P_{scv-4}	-	No. 4 bearing scavenge oil pressure
psia	-	Pounds per square inch, absolute
psid	-	Pounds per square inch, differential
psig	-	Pounds per square inch, gravity
ΔPscreen	-	Screen loss pressure (ΔPscreen = P_{cell}-P_{t2})
P_t	-	Total pressure
P_{t2}	-	Total pressure at fan inlet
$P_{t2.5}$	-	Total pressure at fan discharge
P_{t3}	-	Total pressure at rear compressor exit

6. ABBREVIATIONS (continued).

P_{t4}	-	Total pressure at combustor exit
$P_{t4.5}$	-	Total pressure at fan turbine inlet
P_{t5}	-	Total pressure at fan turbine exit
P_{t6}	-	Total pressure at turbine discharge
P_{t6m}	-	Fan turbine discharge air pressure (core engine and fan bypass air mixed)
P&W	-	Pratt & Whitney
RCDT	-	Rear compressor drive turbine
RCVV	-	Rear compressor variable vane
RED	-	Resolver equivalent degrees
RPM	-	Revolutions per minute
SEC	-	Secondary engine control
SP GR	-	Specific gravity
SN	-	Serial number
SVP	-	Sequencing valve position
TAI	-	Anti-ice air temperature
Tamb	-	Ambient temperature
T_{scv4}	-	No. 4 bearing scavenge oil temperature
T_f	-	Fuel temperature
T_f (FM)	-	Fuel temperature at flowmeter
T_t	-	Total temperature
T_{t2}	-	Total temperature at fan inlet
$T_{t2.5}$	-	Total temperature at fan discharge
T_{t3}	-	Total temperature at rear compressor exit
T_{t4}	-	Total temperature at combustor exit
$T_{t4.5}$	-	Fan turbine inlet temperature (FTIT)
T_{t5}	-	Total temperature at fan turbine exit
T_{t6}	-	Total temperature at turbine discharge
UART	-	Universal Asynchronous (Digital) Receiver/ Transmitter
VAP6	-	Access port 6 vibration
VDCH	-	Diffuser case vibration
VGBV	-	Gearbox vibration
VICV	-	Fan inlet case vibration
W_f	-	Fuel flow
W_{fac}	-	Augmentor core fuel flow
WFC_2	-	Corrected fuel flow
W_{fad}	-	Augmentor duct fuel flow
W_{fgg}	-	Gas generator fuel flow, pph
W_{ftot}	-	Total fuel flow, pph
δ_{t2}	-	Pressure correction factor
θ_t	-	Temperature correction factor

7. THRUST DEFINITIONS AND POWER LEVER SETTINGS - PLA.

(See Tables 1 through 3.)

a. Power lever (throttle) settings on main fuel control - primary mode (see tables 1 and 2).

(1) Maximum thrust (MAX): Highest thrust with PLA at 127 to 130 degrees.

(2) Minimum augmented thrust (MIN AUG): Thrust with PLA at 91 degrees.

(3) Augmentor ignition and minimum augmentation fuel flow occurs with PLA at 91 to 96 degrees.

(4) Intermediate thrust (MIL): Highest nonaugmented thrust with PLA at 83 to 91 degrees.

(5) Part power: Thrust with PLA at 20 to 83 degrees.

(6) IDLE thrust: Thrust with PLA at 15 to 20 degrees. Minimum thrust engine may be continuously operated.

(7) Cutoff: No fuel delivered for combustion with PLA at –2 to 4 degrees.

b. Main fuel control power lever setting - Secondary mode (see table 3).

(1) Augmentation: Augmentor is inhibited with the engine in secondary mode.

(2) Intermediate (MIL), IDLE thrust, and cut off definitions are same as primary mode, in step a.

Table 1. Main Fuel Control Power Lever Settings

Power Lever Angle (PLA) (Degrees)	Engine Function
-2 to 4	No ignition and no fuel flow (CUTOFF)
4 to 11	Fuel flow and ignition on by 11 degrees when increasing PLA; fuel flow and ignition off by 4 degrees when decreasing PLA.
11 to 15	Ignition and fuel flow
15 to 20	Idle power
20 to 83	Part power
91 to 96	Augmentor ignition and minimum augmentor fuel flow by 91 degrees with increasing PLA; Augmentor off by 91 degrees with decreasing PLA.
91 to 96	Augmentor fuel flow and minimum augmentation (Min Aug)
91 to 130	Augmentation range (see table 2)
127 to 130	Maximum augmentation (MAX)

Table 2. Main Fuel Control Power Lever Settings - Augmentor Segment

Power Lever Angle (PLA) (Degrees)	Augmentor Spray Manifold Segment
91 to 96	Augmentor Ignition and minimum fuel flow
91 to 96	Minimum Augmentation
91 to 96	Augmentation, Segment I
96 to 98	Augmentation, Segment II
98 to 102	Augmentation, Segment III
102 to 105	Augmentation, Segment IV
105 to 109	Augmentation, Segment V
109 to 113	Augmentation, Segment VI
113 to 116	Augmentation, Segment VII
116 to 120	Augmentation, Segment VIII
120 to 123	Augmentation, Segment IX
123 to 127	Augmentation, Segment X
127 to 130	Augmentation, Segment XI
127 to 130	Maximum Augmentation

Table 3. Main Fuel Control Power Lever Settings - Secondary Mode

Power Lever Angle (PLA) (Degrees)	Engine Function
-2 to 4	No ignition and no fuel flow
4 to 11	Fuel flow and ignition on by 11 degrees when increasing PLA; fuel flow and ignition off by 4 degrees when decreasing PLA.
11 to 15	Ignition, fuel flow
15 to 20	IDLE
20 to 83	Part power
83 to 91	Intermediate (MIL)
91 and above	Augmentation inhibited, no response to PLA.

8. ENGINE STATION NUMBERS.
(See Figure 2.)

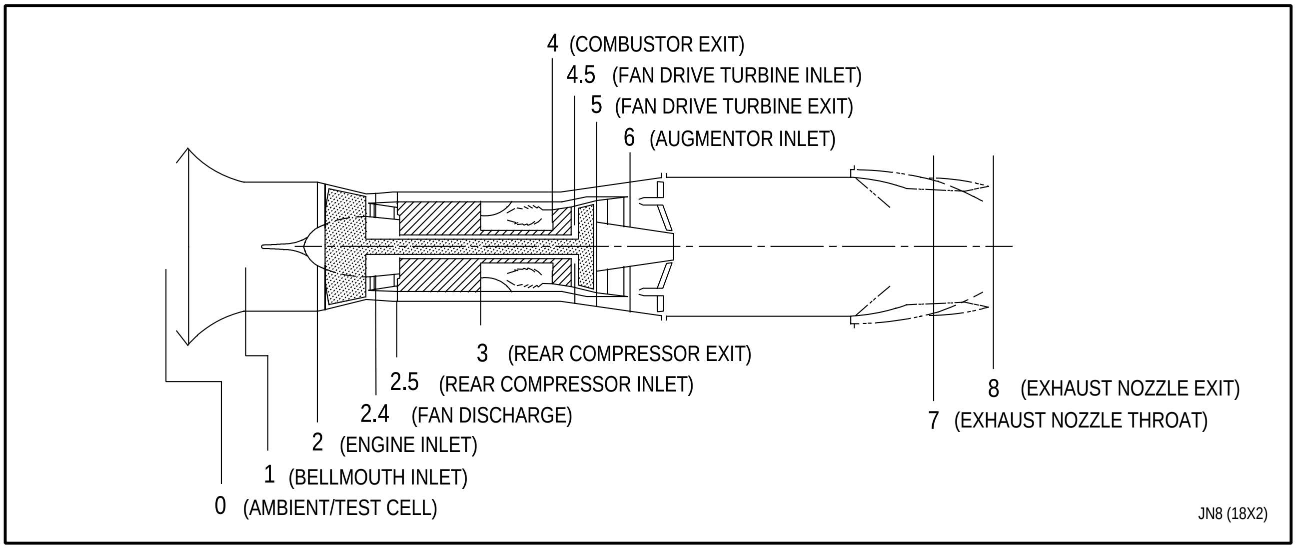


Figure 2. Engine Station Numbers for Identification and Location

9. PRETEST CHECK LIST. Inspections to be performed before test stand run:

a. Perform all pretest requirements in WP 100 00.

b. Check for loose electrical connectors and tube connections.

(1) If loose electrical connector is found, check connector for fuel, oil, and dirt contamination. Clean connector pins, sockets, and insulation with alcohol or freon degreaser. Dry with clean, compressed air.

(2) If tube connection is loose, remove safety wire, torque, and safety wire, as required.

c. Check for extended ∆P indicators on oil filter and main fuel pump filter (Pf1).

(1) If fuel filter indicator is extended, troubleshoot fuel system for contamination per WP 305 00.

(2) If oil filter indicator is extended, troubleshoot oil system for contamination per WP 304 00.

d. Check test cell for tools and foreign objects.

e. Visually inspect engine inlet and exhaust for foreign objects or damage. If damage is found, perform borescope inspection per T.O. 2J-F100-53-5, WP 020 00.

f. If nonrecoverable stall occured, ensure borescope inspection has been performed.

g. Check aircraft form 781E or engine AFTO 95 form for recent engine history. If engine problem is a repeat, review troubleshooting performance for adequacy.

h. Inspect oil system chip detectors, No. 1, 2/3, 4, and 5 bearing compartments. If contamination is found, troubleshoot oil system per WP 304 00.

i. Inspect EDU for system fault indication. If fault is indicated, troubleshoot per WP 100 00.

10. ADDITIONAL ENGINE TEST INFORMATION.

TO BE SUPPLIED

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE OPERATING LIMITS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 24

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	29	7	29	19	7
2 - 3	0	8 - 15	0	20 - 22	0
4	2	16 - 17	1	23	27
5	29	18	0	24 Blank	0
6	21				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Test Requirements	WP 206 00
Engine Prestart	WP 207 00
Emergency Procedures	WP 209 00
Engine Vibration Analysis	WP 218 00
Engine Shutdown	WP 225 00
Engine Troubleshooting - General	WP 501 00
Oil Consumption Check Run	WP 545 00
EDU Event Code 1020: Engine Stall - Idle and Above	WP 552 00
On Condition Maintenance	T.O. 2J-F100-53-2
Inlet/Fan Module Scheduled Maintenance	WP 004 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection - Equipment and Operation	WP 020 00
Core Engine Module	T.O. 2J-F100-53-7

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains engine operating limits and parameters.

2. ENGINE OPERATING LIMITS - GROUND OPERATIONS.
(See Tables 1 through 11.)

a. Engine operations shall be within limits indicated in tables 1 through 11.

b. The limits defined in this section apply only to engines being operated in test cell. They are not valid for installed engines or flight operations.

c. If oil temperature, oil pressure, or breather pressure exceed normal limits, discontinue testing and refer to troubleshooting procedures in WP 501 00.

d. If required, perform oil consumption check run per WP 545 00.

e. If repetitive smoke puffs appear during engine deceleration, discontinue engine operation and refer to troubleshooting procedures in WP 501 00.

Table 1. Engine Operating Limits

Item	Limit	Remarks
Fuel inlet pressure (Pfo)	10 to 60 psig	For steady-state engine operation
	10 to 60 psig	For transient engine operation
Maximum main oil temperature (MOT)	IDLE (See table 2.)	Maximum temperature from tables 2 and 3 depends upon T_{t2} and T_f (FM) temperature. Engine rotor speed should be stable for at least 2 minutes before recording temperature.
	Intermediate (MIL) (See table 3.)	See above remarks.
Oil consumption	One pint per hour (See table 4.)	Determine oil consumption check run and troubleshooting requirements.

CAUTION

Engines operated with zero oil pressure for more than one minute, or for one minute after ignition during start, shall require an engine teardown inspection.

Item	Limit	Remarks
Oil Pressure		
Normal operating range IDLE to Intermediate (MIL)	20 to 80 psid	
Maximum fluctuations		
- IDLE	±5 psi	
- Above IDLE	±10 psi	

Table 1. Engine Operating Limits (continued)

Item	Limit	Remarks
Oil pressure (continued)		
Minimum (including fluctuations):		
- IDLE	15 psid	
- Intermediate (MIL)	30 psid	
Minimum pressure rise IDLE to Intermediate (MIL) in Primary Mode only.	15 psid for minimum of 20 seconds after throttle is at Intermediate (MIL)	Oil pressure below 30 psid at Intermediate (MIL) is unacceptable.
		If oil pressure does not rise 15 psid for 20 seconds minimum, shut down engine. Check oil tank level within 15 minutes. If oil consumption rate is acceptable, and oil pressure rise is still out of limits, troubleshoot.
Maximum oil pressure during cold starts and initial operation	100 psid	100 psid oil pressure is acceptable for no more than 1 minute.

CAUTION

Do not operate engine if No. 4 bearing scavenge pressure is above 65 psig. If pressure exceeds 65 psig, shut down engine and troubleshoot.

Item	Limit	Remarks
Oil pressure, No. 4 bearing scavenge		
Intermediate (MIL) and above	48 psid	Limit to be used only when troubleshooting oil system problems.

Table 1. Engine Operating Limits (continued)

Item	Limit	Remarks

CAUTION

Oil consumption and exhaust smoke check shall be made whenever No. 4 bearing scavenge oil temperature or pressure exceeds limits. Do not operate engine if excessive oil consumption or smoke occur.

Item	Limit	Remarks
Oil breather pressure (P_{mb})	4.0 in. Hg (2.0 psig)	

NOTE

- Observed FTIT is average of $T_{t4.5}$ thermocouple readings.
- Time above 1958°F (1070°C) but less than 1994°F (1090°C) limited to 10 seconds during transients.

Item	Limit	Remarks
Observed FTIT:		
- Above Idle		
Steady State	1958°F (1070°C)	Refer to table 5 if limit exceeded.
Transient	1994°F (1090°C)	
- Start	1472°F (800°C)	Refer to table 6 if limit exceeded.
- IDLE (Steady State)		
Primary	1049°F (565°C)	If limit exceeded, shutdown engine and troubleshoot.
Secondary	1274°F (690°C)	
FTIT Spread		
- IDLE	225°F (125°C)	Spread between maximum and minimum individual FTIT value and average FTIT value.
- Intermediate (MIL)	200°F (111°C)	Spread between maximum and minimum individual FTIT value and average FTIT value.

Table 1. Engine Operating Limits (continued)

Item	Limit	Remarks
N_1 rpm		Refer to table 7 if limit exceeded.
- Maximum steady state limit.	11,000 rpm	**NOTE** 100% N_1 = 10,000 rpm
N_2 rpm	13,800 rpm	Refer to table 8 if limit exceeded.
- Primary Mode		**NOTE** 100% N_2= 14,000 rpm
- Secondary Mode		

NOTE

FTIT and N_2 stability limits should not be added to $N_2$and FTIT overall limits of 13,800 rpm N_2 and 1958°F (1070°C) FTIT.

FTIT, N_1, and N_2 stability limits	1. FTIT may vary ±18°F (± 10°C).	At any PLA
	2. N_1 may vary ±100 rpm.	At any PLA.
	3. N_2 may vary ±140 rpm.	At any PLA.
RCVV angle	See remarks.	When operating in Secondary Mode, if RCVVs do not move toward axial position from cambered stop (–36.0 to –32.0°) during N_2 - increase to 10,500 rpm (uncorrected physical rotor speed), discontinue testing and troubleshoot engine.

Table 1. Engine Operating Limits (continued)

Item	Limit	Remarks
RCVV angle (continued)		. Engine operation with RCVVs in extreme axial position at low $N_2C_{2.5}$ speed will cause compressor blade fatigue and possible compressor damage. If engine is operated with RCVV position between -10 to +0° at N_2 $C_{2.5}$ below 9200 rpm for more than 2 seconds, core module shall be returned to depot for 4th stage compressor blade replacement. Troubleshoot engine to determine cause and corrective action before core replacement.
Time at Intermediate (MIL) or Maximum Power	30 minutes maximum	Thirty minutes at Intermediate (MIL) or Maximum power shall be followed by at least 1 minute at Idle before another run of not more than 30 minutes at Intermediate (MIL) or Maximum power. If limits exceeded, perform complete borescope inspection.

Table 1. Engine Operating Limits (continued)

Item	Limit	Remarks
Sparking or corona	Corona effect	Corona effect is not detrimental to engine or its operation.
	Visible external sparking at engine exhaust.	If heavy spark shower is seen from engine exhaust, discontinue testing and take corrective action. Occasional light sparking from engine exhaust is acceptable.
Torching	Visible flame from engine exhaust nozzle.	Torching not in conjunction with augmentor cancellation is unacceptable. 1. Troubleshoot hot start if torching occurs during engine start. 2. Troubleshoot engine stall (IDLE to MIL) if torching occurs above IDLE.

NOTE

Main oil and fuel temperatures at the flowmeter are in °F.

Table 2. Maximum Allowable Main Oil Temperature (MOT)

Fuel Temperature at Flowmeter Tf(FM) - °F	Main Oil Temperature (MOT in °F)
0	238
1	239
2	240
3	240
4	241
5	242
6	242
7	243
8	244
9	244
10	245
11	246
12	246
13	247
14	248
15	248
16	249
17	250
18	250
19	251
20	251
21	252
22	253
23	253
24	254
25	255
26	255
27	256
28	257
29	257
30	258
31	259
32	259
33	260
34	261
35	261
36	262
37	263
38	263
39	264
40	264

Table 2. Maximum Allowable Main Oil Temperature (MOT) (continued)

Fuel Temperature at Flowmeter Tf(FM) - °F	Main Oil Temperature (MOT in °F)
41	265
42	266
43	266
44	267
45	268
46	268
47	269
48	270
49	270
50	271
51	272
52	272
53	273
54	274
55	274
56	275
57	276
58	276
59	277
60	277
61	278
62	279
63	279
64	280
65	281
66	281
67	282
68	283
69	283
70	284
71	285
72	285
73	286
74	287
75	287
76	288
77	289
78	289
79	290
80	290

Table 2. Maximum Allowable Main Oil Temperature (MOT) (continued)

Fuel Temperature at Flowmeter Tf(FM) - °F	Main Oil Temperature (MOT in °F)
81	291
82	292
83	292
84	293
85	294
86	294
87	295
88	296
89	296
90	297
91	298
92	298
93	299
94	300
95	300
96	301
97	302
98	302
99	303
100	303
101	304
102	305
103	305
104	306
105	307
106	307
107	308
108	309
109	309
110	310
111	311
112	311
113	312
114	313
115	313
116	314
117	315
118	315
119	316
120	316
121	317
122	318
123	318
124	319

Table 2. Maximum Allowable Main Oil Temperature (MOT) (continued)

Fuel Temperature at Flowmeter Tf(FM) - °F	Main Oil Temperature (MOT in °F)
125	320
126	320
127	321
128	322
129	322
130	323
131	324
132	324
133	325
134	326
135	326
136	327
137	328
138	328
139	329
140	329
141	330
142	331
143	331
144	332
145	333
146	333
147	334
148	335
149	335
150	336
151	337
152	337
153	338
154	339
155	339
156	340
157	341
158	341
159	342
160	342
161	343
162	344
163	344
164	345
165	345
166	345
167	345
168	345
169	345
170	345
171	345
172	345

Table 2. Maximum Allowable Main Oil Temperature (MOT) (continued)

Fuel Temperature at Flowmeter Tf(FM) - °F	Main Oil Temperature (MOT in °F)
173	345
174	345
175	345
176	345
177	345
178	345
179	345
180	345
181	345
182	345
183	345
184	345
185	345
186	345
187	345
188	345
189	345
190	345
191	345
192	345
193	345
194	345
195	345
196	345
197	345
198	345
199	345
200	345
−20	225
−19	226
−18	227
−17	227
−16	228
−15	229
−14	229
−13	230
−12	231
−11	231
−10	232
−9	233
−8	233
−7	234
−6	235
−5	235
−4	236
−3	237
−2	237
−1	238

Table 3. Oil Consumption Limits

Run Time, in Minutes	Oil Consumption Limits			Run Time in Minutes	Oil Consumption Limits		
	Pints	Quarts	cc		Pints	Quarts	cc
15	0.25	0.125	118.25	195	3.25	1.625	1537.25
30	0.50	0.250	236.50	210	3.50	1.750	1655.50
45	0.75	0.375	354.75	225	3.75	1.875	1733.75
60	1.00	0.500	473.00	240	4.00	2.000	1892.00
75	1.25	0.625	591.25	255	4.25	2.125	2010.25
90	1.50	0.750	709.50	270	4.50	2.250	2128.50
105	1.75	0.875	827.75	285	4.75	2.375	2246.75
120	2.00	1.000	946.00	300	5.00	2.500	2365.00
135	2.25	1.125	1064.25	315	5.25	2.625	2483.25
150	2.50	1.250	1182.50	330	5.50	2.750	2601.50
165	2.75	1.375	1360.25	345	5.75	2.875	2719.75
180	3.00	1.500	1419.00	360	6.00	3.00	2838.00

3. ENGINE OPERATING LIMITS - ENGINE TEMPERATURE LIMITS DURING RUN (EXCLUDING ENGINE STARTS) AND ENGINE INSPECTION AFTER OVERTEMPERATURE.
(See table 4.)

CAUTION

Engine overtemperatures may be anticipated if there is a rapid increase in fuel flow, if N_2 rpm is above normal, if engine stalls, or if operation is unstable.

a. Move throttle to IDLE if overtemperature is expected or has occurred. If temperature falls below limits as a result of this action, shut down engine normally. If overtemperature continues at IDLE, move throttle to CUTOFF and shut down engine per emergency procedures in WP 209 00.

CAUTION

Do not restart engine until cause of overtemperature is corrected. Both compressors shall turn freely before engine is restarted.

b. If FTIT exceeds limits specified in table 4, perform corrective action.

c. Continue testing after taking corrective action. If parts were replaced, refer to WP 206 00 for additional test requirements.

Table 4. Engine Overtemperature Limits and Corrective Action (Excluding Engine Starts)

EDU Level	FTIT °F(°C)	Time Duration Range		
		0-5 Secs.	6 Secs. - 10 Secs.	MT 10 Secs.
-	1958°F to 1994°F (1070°C to 1090°C)	X	X	A
-	1994°F to 2008°F (1090°C to 1098°C)	A	A	A
LEV 1	MT 2008°F (MT 1099°C)	A	B	B
LEV 2	MT 2034°F (MT 1112°C)	B	C	C
LEV 3	MT 2034°F (MT 1112°C)	B	C	C
LEV 4	MT 2073°F (MT 1134°C)	C	C	C

Symbol	Corrective Action
X	No corrective action.
A	1. Record peak temperature and duration of overtemperature in engine log and in each turbine AFTO 44 form. 2. Determine and correct cause of overtemperature. 3. Inspect exhaust duct for foreign material.
B	1. Same as A. 2. Borescope inspect combustor and turbine areas (AP4 and AP6) for damage.
C	1. Same as A. 2. Terminate test and perform teardown inspection of engine combustor section.

4. ENGINE OPERATING LIMITS - ENGINE TEMPERATURE LIMITS DURING START AND ENGINE INSPECTION AFTER START OVERTEMPERATURE.
(See table 5.)

Table 5. Engine Overtemperature (Hot Start) Limits and Corrective Action

EDU Level	Overtemperature limits FTIT °F(°C)	Corrective Action Code Time Duration Range - Seconds	
		0-5	MT 5
1	1472 to 2009 (800 to 1098)	A	A
2	2010 to 2034 (1099 to 1112)	A	B
3	2035 to 2073 (1113 to 1134)	B	C
4	GT 2073 (GT 1134)	C	C

Symbol	Corrective Action
A	Investigate and correct cause of overtemperature. Troubleshoot start anomaly per WP 509 00.
B	1. Record temperature and duration in engine log and in turbine AFTO 44 Form (Core and Fan Drive Turbine modules) for each instance. 2. Inspect exhaust duct for foreign particles. 3. Perform rotation check of N_1 and N_2 rotors. 4. Perform hot section borescope inspection of AP4 main ignitor ports and AP6. 5. Investigate and correct cause of overtemperature.
C	Terminate test and perform teardown inspection of combustor section.

5. ENGINE OPERATING LIMITS - OVERSPEED LIMITS AND OVERSPEED INSPECTION.
(See tables 6 and 7.)

a. If N_1 speed exceeds limits of table 6, perform following:

(1) Shut down engine per emergency procedures in WP 209 00.

(2) Perform corrective action required per table 6.

b. If N_2 speed exceeds limits of table 7, perform following:

(1) Shut down engine per emergency procedures in WP 209 00.

(2) Perform engine rotation inspection per WP 209 00.

(3) After rotation inspection, perform corrective action per table 7.

Table 6. Steady State N_1 Rpm Overspeed Limits and Corrective Action

N_1 rpm	Duration	Corrective Action
Less than 11,000	Any duration	No corrective action required.
11,000 to 11,850	Any duration	1. Troubleshoot to determine cause of speed schedule error. 2. Record maximum N_1 rpm in engine forms.
Greater than 11,850	Any duration	1. Record maximum N_1 rpm in engine forms. 2. Reject engine for N_1 overspeed inspection.

Table 7. Steady State N_2 Rpm Overspeed Limits and Corrective Action

N_2 rpm	Duration	Corrective Action
Less than 13,800	Any duration	No corrective action required.
13,800 to 14,300	Any duration operating in Primary Mode	Troubleshoot.
	Any duration operating in SEC Mode	Record maximum N_2 rpm in engine forms.
More than 14,300	Any duration	1. Reject core, and fan drive turbine modules for depot overspeed/ overtemperature inspections. 2. Record maximum N_2 rpm in engine forms.

6. VIBRATION LIMITS.
(See table 8.)

a. Monitor engine vibration during all engine testing.

b. Turn accelerometer switch on test cab vibration analyzer to VICV. Monitor this location during all engine testing, except when selector is used to read other vibration pickups. Vibration levels should not exceed limits in table 8.

c. Vibration in excess of limits indicates improper assembly or mechanical problems which may develop during testing.

(1) If vibration levels during transient acceleration exceed table 8 limits, stop acceleration and stabilize for one minute.

(2) If vibration levels fall within table 8 limits following stabilization, continue acceleration.

(3) If vibration levels exceed table 8 limits, return engine to an acceptable operating condition and determine cause of vibration per WP 218 00.

d. Monitor vibration pickups per table 8.

e. Position vibration analyzer switches per WP 218 00 for overall vibration measurements.

f. When limits in table 8 are exceeded, position vibration analyzer switches per WP 218 00 for component vibration analysis and exceeded overall limits.

Table 8. Vibration Limits

Vibration Pickup Location	Overall Limits - Mils Steady State	
	A	B
Fan inlet case (VICV)	3.1	6.2
Diffuser case (VDCH)	2.2	4.4
Gearbox (VGBV)	2.7	5.4
Turbine case (VAP6)	3.1	6.2

A = Limit on PN VIC974FH vibration analyzer
B = Limit on Spectral Dynamics, Model 4112 and Trigtek Model 623B vibration analyzer

7. ENGINE EXHAUST SMOKE - TEST RUN INSPECTION.

a. Occasional smoke puffs occurring at engine exhaust during acceleration and deceleration are normal, provided there is no evidence of oil system malfunction, such as excessive oil consumption or low oil pressure.

b. If exhaust smoke persists, inspect oil system to determine cause and corrective action.

8. OVERBOARD FUEL AND OIL DRAIN LIMITS.

(See table 9.)

NOTE

Individual drain limits represent normal operational limits and are not indications of impending failure.

a. During test run, collect, measure, and record amount of fuel draining overboard from gearbox, front, and rear drains.

b. Troubleshoot leakage if table 9 limits are exceeded.

Table 9. Overboard Fuel and Oil Drain Limits - At Steady State Running Conditions

NOTE

All fuel and lubrication system components are allowed external leakage. External leakage at the rate of one drop every 5 minutes, from any one leakage source, under static or running condition is allowable.

* Twenty drops equal approximately one cubic centimeter (cc) of fuel or lubricating oil.

** Inspect augmentor duct. If source of leak cannot be located, motor engine to blow fuel or oil out of duct. Otherwise, troubleshoot engine for a fuel or oil leak.

*** If fuel leakage is noted from Pb line, borescope hot section AP4 and AP6.

Main Overboard Drain - Location	Main Overboard Drain - Limit	Remarks	Individual Unit Drain	Fluid	Individual Unit Drain - Limits*
Gearbox	1.5 cc/min	If gearbox overboard drain limit is exceeded; isolate and repair or replace component.	PTO drive pad	Oil	15 drops/min
			Breather overboard outlet		
Front (OD-1)	4.1 cc/min	If front overboard drain limit exceeded, isolate and repair or replace component.	P&D valve	Fuel	15 drops/min
			P&D valve capped		0 drops/min
			Augmentor fuel pump		20 drops/min
			Compressor bleed cylinder		0 drops/min
			Reduction gearbox	Oil and fuel	45 drops/min

Table 9. Overboard Fuel and Oil Drain Limits - At Steady State Running Conditions (continued)

Main Overboard Drain - Location	Main Overboard Drain - Limit	Remarks	Individual Unit Drain	Fluid	Individual Unit Drain - Limits*
Rear (OD-2)	1.5 cc/min	If rear overboard drain limit exceeded, isolate and repair or replace component.	CENC	Fuel	30 drops/min
			Augmentor duct	Fuel and oil	0 drops/min**
			DEEC transducer moisture traps	Fuel	0 drops/min***

9. START TIME LIMITS.
(See table 10.)

a. During Primary and Secondary engine control mode starts, a running clock shall be monitored.

b. Time should be calculated for:

(1) Time from throttle advance to at least 16 degrees PLA to engine ignition (rapid FTIT rise observed).

(2) Time from ignition to engine acceleration to 8400 N_2 rpm.

Table 10. Start Time Limits

Time	Primary Mode	Secondary Mode
To ignition	30 seconds *	30 seconds *
Ignition to 8400 N2 rpm	40 seconds	60 seconds
*Does not apply for preserved engine starts.		

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE TEST REQUIREMENTS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Introduction - Testing Procedures	WP 200 00
Engine Operating Limits	WP 205 00
Ground Safety Precautions	WP 208 00
Emergency Procedures	WP 209 00
Engine Start Procedures	WP 210 00
Engine Acceptance Test	WP 212 00
Engine Shutdown	WP 225 00
Engine Troubleshooting - General	WP 501 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION

a. This work package contains instructions for determining the type of testing required based on the maintenance performed on the engine.

2. DETERMINING MINIMUM TESTING REQUIRED AFTER ENGINE MAINTENANCE. (See Tables 1 and 2.)

a. Engine testing required after maintenance depends on work performed on engine. This paragraph provides procedure for identifiying amount of testing required to prove satisfactory engine performance.

b. The procedure is:

(1) Review engine maintenance records to determine what maintenance action was taken.

(2) Determine test(s) required for component serviced:

(a) Locate component name in left column of table 1 or table 2, as applicable.

(b) Check boxes on right of component name. Bulleted boxes indicate tests required for component. Test names are in column headings.

(3) Record required tests per table 1 and 2.

(4) Perform test procedures in WP 200 00.

c. Check core engine and rear compressor drive turbine rotor AFTO Form 95 (Engine Historical Data) for supplemental test or inspection requirements. AFTO Form 95f will be annotated for one or more tests or inspection requirements based on engine maintenance. Core run-in test is required if engine has zero-time core, high compressor with any new abradable rubstrips, or high compressor in which compressor case halves have been replaced.

3. FAULTS OCCURRING AFTER COMPONENT MAINTENANCE.

a. Due to closed-loop DEEC operation, it is possible to generate DEEC faults which result from fuel plumbing lines being drained. These faults may be reset without further maintenance under the following conditions:

(1) A fuel-supplied component has been replaced or plumbing disconnected which drained fuel from control system.

(2) Faults occur during first start following maintenance performed in step (1).

(3) Faults occur during first start for depreservation or after engine reassembly, following module maintenance.

(4) One or more of following faults occur as a result of conditions described in steps (2) and (3):

- 4001 - Exhaust Nozzle Position Out Of Limits
- 4011 - CIVV Position Out Of Limits
- 4021 - AFC Segment Sequencing Valve Position Out Of Limits
- 4031 - AFC Core Metering Valve Position Out Of Limits
- 4041 - AFC Duct Metering Valve Position Out Of Limits
- 4052 - RCVV Position Out Of Limits
- 4064 - MFC Metering Valve Position Out of Limits
- 4130 - MFC SEC P_{Sensor} Malfunction
- 4140 - MFC SEC T_{Sensor} Malfunction
- 4190 - Mode Select Switch/Solenoid Malfunction

b. If above criteria are met, perform the following:

(1) Shut down engine per WP 225 00.

(2) Clear EDU per WP 656 00.

(3) Perform preserved engine start and leak check per WP 210 00.

4. FOLLOW-ON MAINTENANCE.

a. After determining amount of testing required per tables 1 and 2, perform engine prestart per WP 207 00.

Table 1. Minimum Test Requirements After Module/Component Maintenance

MODULE/REMOVAL/INSTALLATION	Core Run-In (If Reqd. by AFTO Form 95)	Engine Accept. Test	Sec Funct. Check	Prim. Funct. Check	Ign. Sys. Funct. Check	Accel/ Decel Check	Idle Funct. Check
Augmentor	-	-	-	-	-	-	•1
Core	•	•	-	-	-	-	-
Compressor	•	•	-	-	-	-	-
Fan Drive Turbine	-	•3	-	-	-	-	-
Fan	-	•	-	-	-	-	-
Gearbox	-	-	-	-	-	•2	-
Rear Compressor Turbine	•	•	-	-	-	-	-
Component Removal/ Installation							
Bearing	-	•	-	-	-	-	-
Blades	-	•	-	-	-	-	-
- Rear Compressor Turbine	-	•	-	-	-	-	-
- Rear Compressor	-	•	-	-	-	-	-
- Fan	-	•	-	-	-	-	-
- Fan Drive Turbine	-	•	-	-	-	-	-
Cases Fan Ducts (F & R)	-	-	-	-	-	•2	-
- Fan Inlet	-	-	-	-	-	•2	-
Combustion Chamber	-	•	-	-	-	-	-
Fuel Nozzle	-	•	-	-	-	-	-
Spray Rings	-	-	-	-	-	•	-
Vanes	-	•	-	-	-	-	-
- Rear Compressor Turbine	-	•	-	-	-	-	-
- Fan Drive Turbine	-	•	-	-	-	-	-
7th through 12th Rear Compressor Stators	•	•	-	-	-	-	-
OD Tip Shrouds (Rear Compressor)	•	•	-	-	-	-	-
ID Tip Shrouds (Rear Compressor)	•	•	-	-	-	-	-
1st Stage Turbine Duct and Vane Support	•	•	-	-	-	-	-
2nd Stage Turbine Air Sealing Ring	•	•	-	-	-	-	-
Case and Duct Set (LPT)	•	•	-	-	-	-	-

Reference Notes

(1) Engine START and IDLE functional checks are required after augmentor replacement, if previously installed augmentor experienced a burn-through.
(2) Monitor vibrations during engine run.
(3) If fan drive turbine has new second stage turbine duct segments, core run-in is also required per WP 211 00.

Table 2. Minimum Test Requirements After Non-Modular Component Maintenance

Reference Notes

(1) Functional check using PWA 50025 ignition system test set is optional.

(2) Monitor PLA position with EMSE during functional check. During START, monitor PLA position (0024) at CUTOFF and IDLE. Terminate start if either value is out of limits:

Throttle	PLA
CUTOFF IDLE	–2 –4 degrees 15 –20 degrees

	Engine Accept. Test	Sec Funct. Check	Prim. Funct. Check	Ign. Sys. Funct. Check	Accel/ Decel Check	Idle Funct. Check
COMPONENT REMOVAL/INSTALLATION						
CIVV Control EHV	-	-	-	-	-	•
DEEC, Board, and Sensor	-	-	•	-	-	-
Augmentor Fuel Pump Controller	-	-	-	-	•	-
Push-Pull RCVV	-	•	-	-	-	-
Cable-Electric	-	-	-	-	-	-
- Temperature	-	-	-	-	-	•
- Ignition	-	-	-	•	-	-
- Gas Generator Control	-	-	-	-	-	•
- Augmentor	-	-	-	-	-	•
- Power and Speed	-	-	-	-	-	•
- Actuator Cable	-	-	-	-	-	•
- 1553 MUX Bus Cable	-	-	-	-	-	•
Cylinder	-	-	-	-	-	-
- CIVV	-	-	-	-	-	•
- RCVV	-	-	•	-	-	-
Filters: Main Fuel Pump and Oil	-	-	-	-	-	•
Generator, Stator, and Rotor	-	-	-	-	-	•
Ignitor	-	-	-	•1	-	-
LOD	-	-	-	-	-	•
EDU and Board	-	-	-	-	-	•
Exciter	-	-	-	•1	-	-
Augmentor Fuel Pump	-	-	-	-	-	•
Main Fuel Pump	-	-	-	-	-	•
Oil Pump	-	-	-	-	-	•
FTIT Probe	-	-	-	-	-	-
PT6 Probe	-	-	•	-	-	-
TT2 Probe	-	-	-	-	-	•
N1 Sensor	-	-	-	-	-	•
P&D Valve	-	-	-	-	-	•
Anti-Icing Valve	-	-	-	-	-	•
Fuel/Oil Cooler	-	-	-	-	-	•
PS2 probe	-	-	-	-	-	•

Table 2. Minimum Test Requirements After Non-Modular Component Maintenance (continued)

	Engine Accept. Test	Sec Funct. Check	Prim. Funct. Check	Ign. Sys. Funct. Check	Accel/ Decel Check	Idle Funct. Check
COMPONENT REMOVAL/INSTALLATION						
Start Bleed Actuator	-	-	-	-	-	•
ENPT	-	-	-	-	-	•
MOPT	-	-	-	-	-	•
Main Fuel Control	-	•	•	-	-	-
- Ignition Switch	-	-	-	•	-	-
- S/B Solenoid	-	-	-	-	-	•
- Mode Solenoid	-	•	-	-	-	•
- RCVV EHV	-	-	•	-	-	-
- MV EHV	-	-	•	-	-	-
- Metering Valve Resolver	-	-	-	-	-	•
- PLA Resolver (See Note 2)	-	•	-	-	-	-
- TT2 Sensor	-	-	-	-	-	•
Augmentor Fuel Control	-	-	-	-	•	-
- Core MV EHV	-	-	-	-	•	-
- Duct MV EHV	-	-	-	-	•	-
- Seg Seq EVH	-	-	-	-	•	-
- Ignition Relay	-	-	-	-	•	-
- Duct Metering Valve Resolver	-	-	-	-	-	•
- Core Metering Valve Resolver	-	-	-	-	-	•
- Segment Sequence Valve Resolver	-	-	-	-	•	-
CENC, EHV, and Air Motor	-	-	-	-	-	•
Oil Tank	-	-	-	-	-	•
Primary/Secondary Flex Shafts	-	-	-	-	-	•
Nozzle Actuator	-	-	-	-	-	•
Breather Pressurizing Valve	-	-	-	-	-	•

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE PRESTART

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	0	6 Blank	0		

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Start Procedures	WP 210 00
Engine Acceptance Test	WP 212 00
Engine Shutdown	WP 225 00
Engine Troubleshooting - General	WP 501 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains engine prestart instructions.

2. PRELIMINARY INSTRUCTIONS.

a. Perform all pretest requirements in WP 100 00.

b. Review engine operating limits in WP 205 00.

c. Determine engine test requirements per WP 206 00.

3. ENGINE PRESTART.

(See Table 1.)

Table 1. Prestart

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
1.	Ensure engine pretest procedures have been completed correctly.	All required test tooling is properly installed, secured, or connected to engine.	
2.	If acceptance test is being performed: (a) Using hydrometer* measure and record fuel specific gravityin appropriate test cell support equipment.		Perform check again using second fuel sample.
3.	Inspect engine inlet and exhaust nozzle for foreign objects or damage.	None found.	Determine source of object and take appropriate measures to prevent engine damage.
4.	Visually inspect bellmouth and starter gearbox for damage.	None found.	
5.	Ensure right side RCVVs and CIVVs are in the following position: (a) RCVV - pushrod extended (b) CIVV - pushrod retracted	RCVV and CIVV are fully cambered.	Place actuators in appropriate position, using PWA 50096 hydraulic cart.
	NOTE Enter 00-0000 aircraft tail number into EDU for test stand application.		
6.	If not previously accomplished record all engine data from EDU.	No faults indicated	Reset faults. If troubleshooting engine, record faults.
7.	Set up engine monitoring support equipment (EMSE) to monitor engine parameters during tests.		
8.	If not previously accomplished service engine oil system	Oil level within limits. Engine records indicate servicing.	Service oil system with MIL-L-7808.

* Hydrometer

- FSN 6630-01-017-1628 or
- FSN 6030-00-245-8377

4. FOLLOW-ON MAINTENANCE.

a. Review ground safety precautions and emergency procedures in WP 208 00 and WP 209 00.

b. Start engine per WP 210 00.

WORK PACKAGE

TECHNICAL PROCEDURES

GROUND SAFETY PRECAUTIONS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 10

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 10	0				

REFERENCE MATERIAL REQUIRED

None

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
	Lead, Ignition shorting ---------- Detail of PWA 50025 test set	*PWA 52176

ILLUSTRATED SUPPORT EQUIPMENT

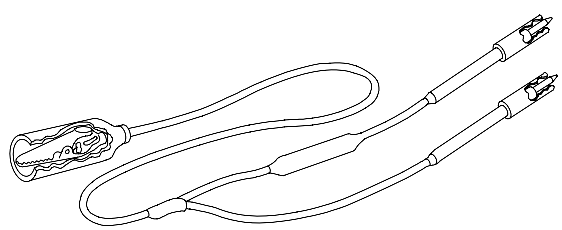


Figure T1. PWA 52176 Lead

1. INTRODUCTION.

a. This work package contains ground safety precautions.

2. GENERAL.

a. Dangers associated with jet engines are air intake, engine exhaust, jet wake, and engine ignition. Engine noise, exhaust gas toxicity, and contact with jet fuels and lubricating oils also require special safety precautions.

3. ENGINE AIR INLET.

WARNING

Keep clear of engine air inlet when engine is operating. Suction developed when engine is operating may cause serious or fatal injury to persons near air inlet.

CAUTION

Secure clothing and personal articles, such as hats, eye glases, and tools when working around an operating engine. Even at IDLE, suction at air inlet is enough to draw in small loose objects.

4. ENGINE EXHAUST.

WARNING

Keep clear of engine exhaust when engine is operating. Temperature and velocity of exhaust gases may cause serious or fatal injury to persons in exhaust area.

a. High temperature, high velocity exhaust gases discharged at rear of engine present a serious hazard to persons working on or around engine. Exhaust gases velocities may cause serious or fatal injury.

5. ENGINE JET WAKE.

(See Figure 1.)

WARNING

Keep clear of engine jet wake during engine run. Exhaust gas velocities are sufficient to cause injury, even at seemingly safe distances from exhaust nozzle.

CAUTION

Observe all fire precautions while preparing to operate and while operating engine. Remove flammable materials from engine area.

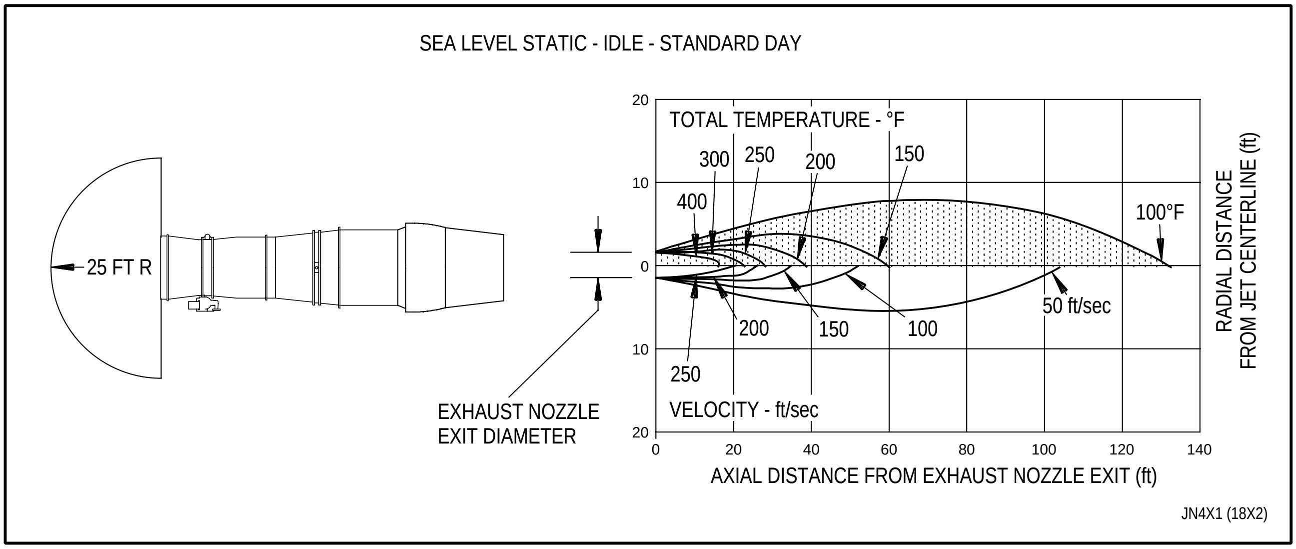


Figure 1. Jet Wake Diagram (Sheet 1 of 3)

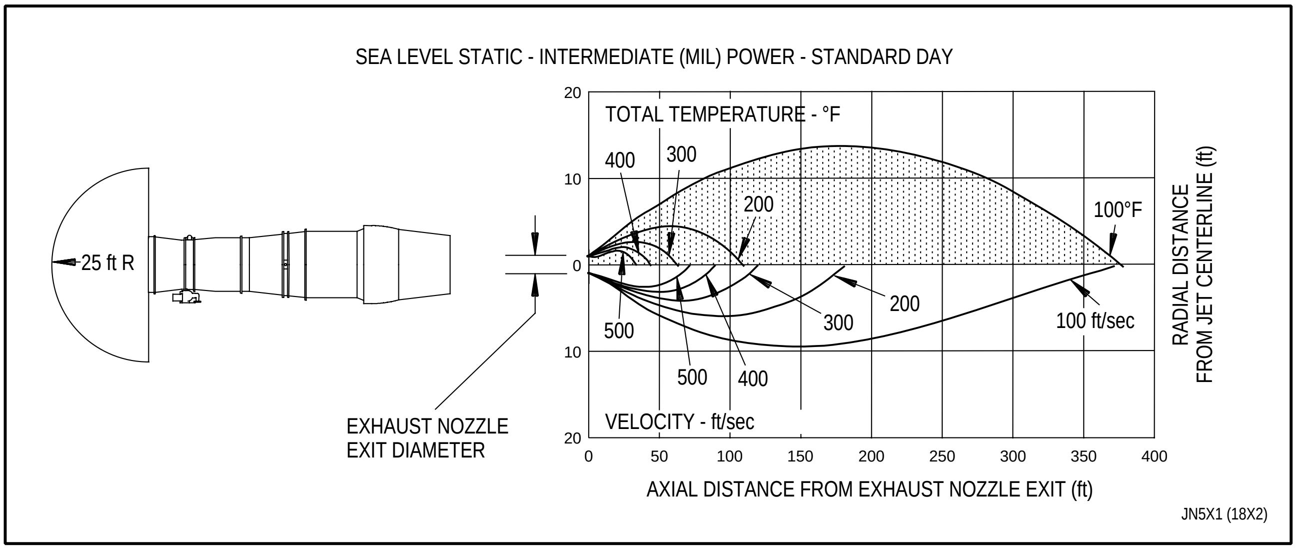


Figure 1. Jet Wake Diagram (Sheet 2 of 3)

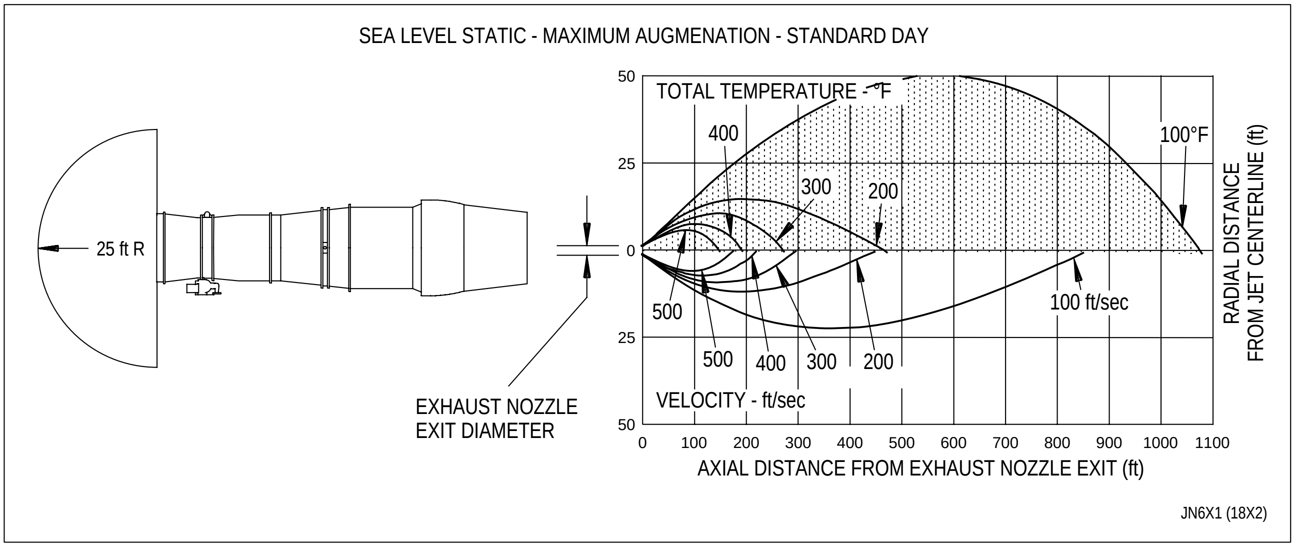


Figure 1. Jet Wake Diagram (Sheet 3 of 3)

6. ENGINE IGNITION.

(See Figure 2.)

WARNING

High voltages developed by engine ignition system are capable of causing serious, or fatal shock. Do not test or service high tension components, (exciters, high tension leads, igniters) until exciter high voltage outputs have been properly grounded.

a. High voltages developed by the engine ignition system are hazardous to personnel. Ignition system must be properly grounded before performing any maintenance on engine.

WARNING

Ensure grounding lead of PWA 52176 shorting lead is connected to ground when grounding any ignition component.

CAUTION

Do not bend special purpose electrical cables less than five-inch radius. Inner conductors or outer wire braid may be damaged if cable is bent in smaller radius.

b. Connect alligator clip of ground lead (of PWA 52176 shorting lead) to suitable ground. (See figure 2.)

c. Discharge ignition components by connecting resistor lead (of PWA 52176 shorting lead) probe to component output for approximately one minute; then touch ground lead probe to same point.

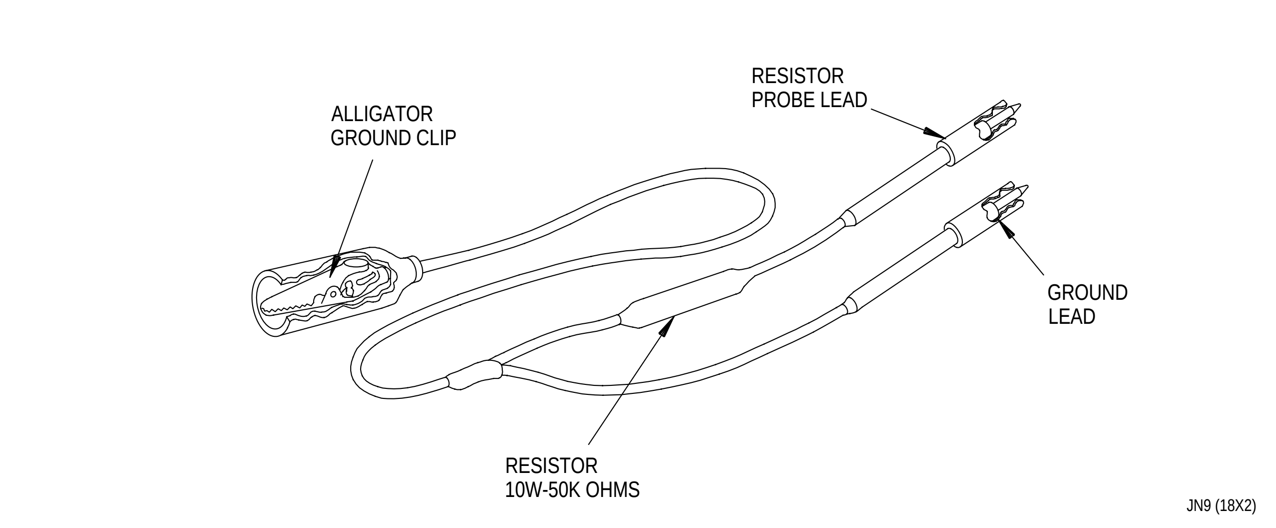


Figure 2. PWA 52176 Shorting Lead (Detail of PWA 50025 Test Set)

7. ENGINE NOISE.
(See Figure 3.)

WARNING

Jet engine noise can impair hearing. Wear proper ear protection during all engine operations, to avoid hearing loss and possible ear injury.

a. Wear proper ear protection, such as MIL-P-38268 noise muffs, during normal engine operations.

b. Supplement approved noise muffs with approved ear plugs when engine is operating.

c. During engine test operations, do no enter test cell when engine is operating above IDLE.

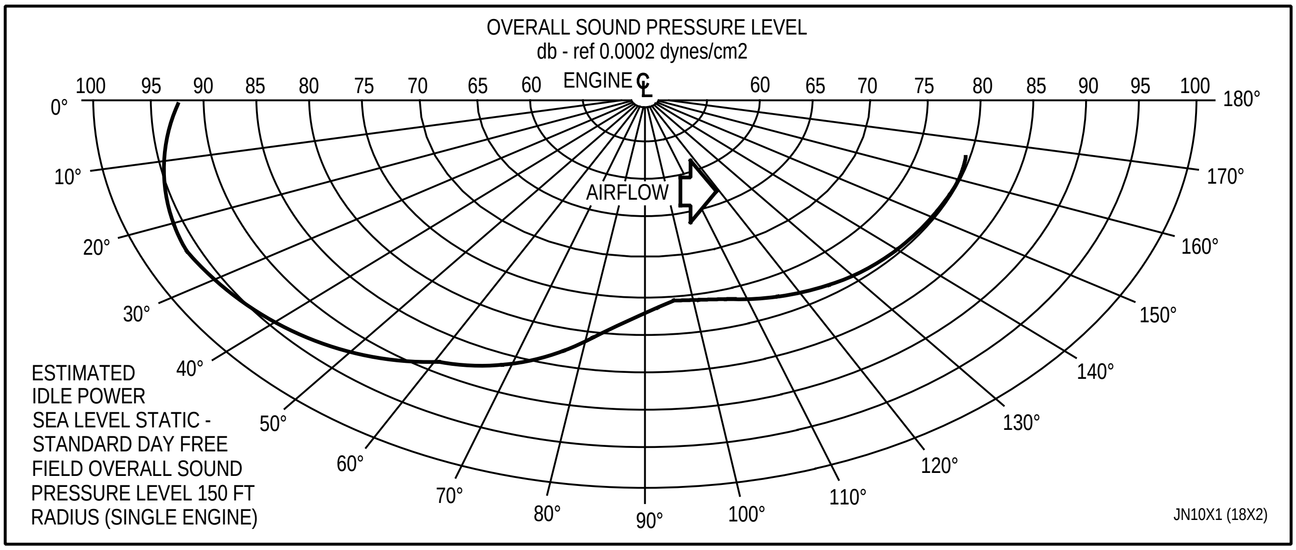


Figure 3. Engine Noise Pressure (Sheet 1 of 3)

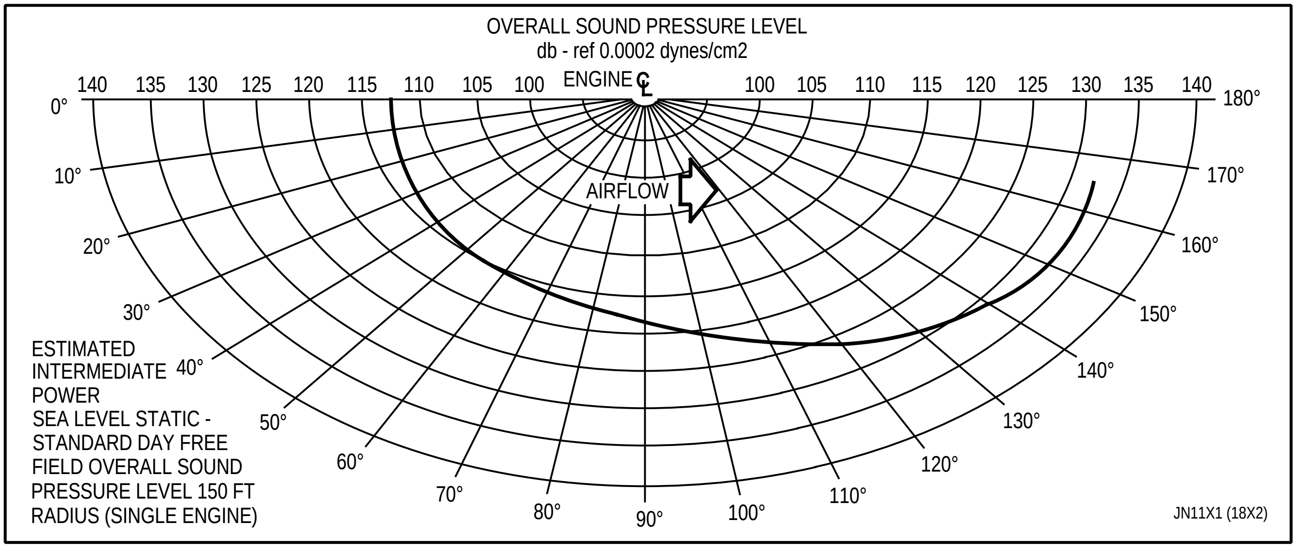


Figure 3. Engine Noise Pressure (Sheet 2 of 3)

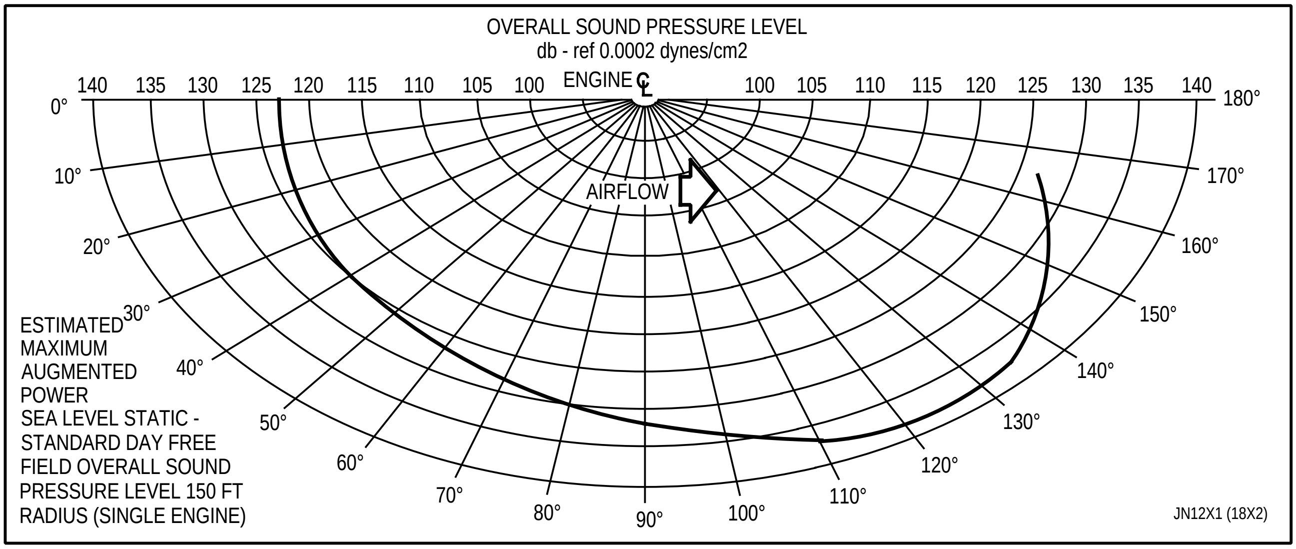


Figure 3. Engine Noise Pressure (Sheet 3 of 3)

8. ENGINE EXHAUST - TOXICITY.

WARNING

Jet engine exhaust gas components may not be specifically toxic, but they contain eye and respiratory irritants. Avoid exposure to concentrations of exhaust gas in confined spaces.

a. Tests indicate that engine exhaust gas carbon monoxide content is relatively low, but irritating gas with disagreeable odors are present. Exposure to these gases cause eyes to burn and water. Respiratory irritation may also occur from breathing exhaust gases. Avoid high concentrations of exhaust gases.

9. ENGINE FUELS AND LUBRICATING OILS.

WARNING

- Avoid risk of serious or fatal burns. Do not wear clothing saturated with jet fuel or engine lubricating oil.
- Prolonged skin contact with jet fuel and engine lubricating oil may cause dermatitis. Wash skin thoroughly after exposure and remove fuel and oil soaked clothing.

a. Jet fuel and engine lubricating oil may cause problems for engine test and maintenance personnel.

b. Prevent dry skin by avoiding continued contact with fuel and lubricating oil. When exposed, remove fuel and oil soaked clothing and wash exposed skin thoroughly with soap and water.

c. Lubricating oil stains clothing.

d. Fuel and oil saturated clothing is flammable and should not be worn, especially near possible external sparking sources.

WORK PACKAGE

TECHNICAL PROCEDURES

EMERGENCY PROCEDURES

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	28	4	28	5 - 6	0
2 - 3	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains procedures for handling emergencies occurring in or around the engine or test cell while engine is being tested. It covers emergencies such as internal and external fires, loss of electric power, loss of throttle control, and over-limit engine operation.

2. EMERGENCY PROCEDURES.

(See Table 1.)

a. Perform engine overtemperature inspection per WP 205 00, if required.

Table 1. Emergency Procedures

Emergency	Action
Loss of electrical power - Electric throttle	1. Move throttle to CUTOFF. 2. Engage CELL FUEL CLOSED push button switch. 3. Turn ENGINE START on at 2000 or below N_2 rpm indication. 4. Motor engine until FTIT is below 392°F (200°C) or as long as possible. 5. Perform rotation inspection per paragraph 3, before next start.
Loss of electrical power and communication:	1. Move throttle to CUTOFF. 2. Engage CELL FUEL CLOSED push button switch. 3. Turn ENGINE START on at 2000 or below N_2 rpm indication. 4. Motor engine until FTIT is below 392°F (200°C). 5. Perform rotation inspection per paragraph 3, before next start.

Table 1. Emergency Procedures (continued)

Emergency	Action
Auto Acceleration	1. Move throttle to CUTOFF. 2. Engage CELL FUEL CLOSED push button switch. 3. Turn ENGINE START on at 2000 or below N_2 rpm indication. 4. Motor engine until FTIT is below 392°F (200°C). 5. Perform rotation inspection per paragraph 3, before next start.
Augmentor fire - shutdownfrom augmentation	1. As soon as possible, motor engine for at least 90 seconds. 2. If starter cannot be used to motor engine, allow fire 2 minutes to burn itself out. 3. If fire burns more than 2 minutes, use gaseous nitrogen (N_2), carbon dioxide (CO_2), or Halon 1211 to extinguish fire. 4. Inspect augmentor duct and nozzle for fire damage before restarting engine. Restart engine only if augmentor module is serviceable. 5. Perform rotation inspection per paragraph 3 before next start.
Engine speed operating limits exceeded or over-limit operation imminent	1. Move throttle to CUTOFF. 2. Engage CELL FUEL CLOSED push button switch. 3. Motor engine until FTIT is below 392°F (200°). 4. Perform rotation inspection per paragraph 3 before next start.
Internal fire during start	1. Move throttle CUTOFF. 2. Engage CELL FUEL CLOSED push button switch. 3. Continue to motor engine until fire is extinguished and FTIT is below 392°F (200°C). 4. Perform rotation inspection per paragraph 3 before next start.
Engine overtemperature during start	1. Move throttle to CUTOFF. 2. Engage CELL FUEL CLOSED push button switch. 3. If starter is engaged, motor engine until FTIT is below 392°F (200°C). 4. If starter is not engaged, turn ENGINE START on at 2000 or below N_2 indication, and motor engine until FTIT is below 392°F (200°C). 5. Perform engine overtemperature inspection.

Table 1. Emergency Procedures (continued)

Emergency	Action
Engine overtemperature during engine run	1. If throttle is above IDLE, snap throttle to IDLE. 2. If FTIT is above limits, move throttle to CUTOFF. 3. Turn ENGINE START on at 2000 or below N_2 rpm indication. 4. Motor engine until FTIT is below 392°F (200°C).
Internal fire	1. Move throttle to CUTOFF. 2. Engage CELL FUEL CLOSED push button switch. 3. Turn ENG START on at 2000 or below N_2 rpm indication. 4. Motor engine until fire is extinguished and FTIT is below 392°F (200°C). 5. Perform rotation inspection per paragraph 3.
External fire	**WARNING** Do not discharge test cell fire extinguisher until cell has been cleared of all personnel. 1. Evacuate test cell and call fire dept (Dial 117). 2. Close Remote CELL FUEL valve. 3. Depress EMERGENCY SHUTDOWN button (red mushroom). 4. Activate total flood cardox system. 5. Activate spurt cardox system. 6. If Fire is uncontained, shutdown adjacent test cell and evacuate control room. 7. Account for all personnel.
Engine stall or stagnation	1. If stall occurs, snap throttle to IDLE. 2. If stall clears, shut down engine. 3. If stall does not clear (stagnation), move throttle to CUTOFF and monitor FTIT indicator. 4. Turn ENGINE START on at 2000 or below N_2 rpm indication. 5. Motor engine with starter until FTIT is below 392°F (200°C).

3. ENGINE ROTATION INSPECTION.
(See Figure 1.)

NOTE

- The following N_2 rotor rotation inspection is required when N_2 rotor seizure or unusual noise occurs during engine shutdown. This procedure may be accomplished with engine installed on test cell or ALC 3000E transportation trailer.
- If engine is shutdown for any reason before completion of core run-in procedure, temporary N2 rotor seizure may occur. Seizure is not detrimental to engine and rotor will free as engine thermally equalizes (typically less than 2 hours). Further engine inspection and disassembly is not required when seizure clears.

a. Rotate N_2 rotor using a standard 1 5/8 inch, open-end wrench on hex nut of remote gearbox driveshaft coupling. (See figure 1.)

b. Check rotation of N_1 rotor by turning fan inlet blades by hand.

c. If engine rotates freely and without any unusual noise, no damage has occured to N_1 or N_2rotors.

NOTE

N_2 rotor seizure may be located either in engine or gearbox.

d. IF N_1 or N_2 rotors cannot be rotated or make unusual noises, further engine inspection and disassembly is required per T.O. 2J-F100-53-5.

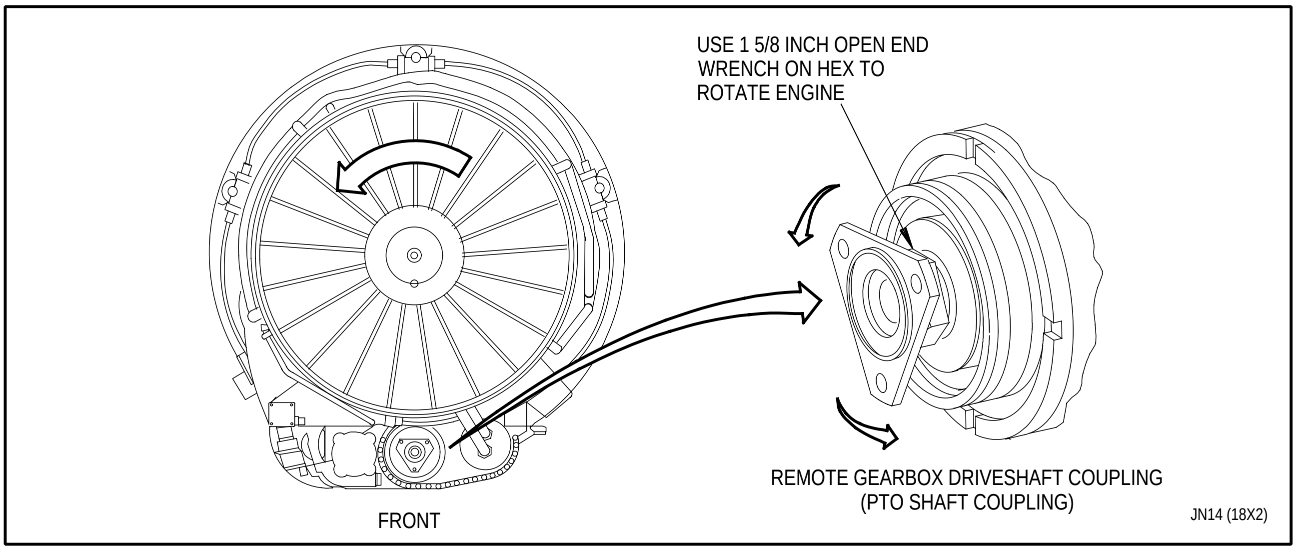


Figure 1. Rotating N_2 Rotor Using Wrench

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE START PROCEDURES

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 28

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	22	8	0	14	6
2 - 4	0	9 - 10	6	15	0
5	7	10A	7	16 - 17	6
6	6	10B Blank	6	18 - 19	22
6A	22	11	6	20 - 21	0
6B Blank	5	12	22	22	6
7	22	13	0	23 - 24	0

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Shutdown	WP 225 00
Engine Troubleshooting - General	WP 501 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
Lockwire (0.032 inch diameter)	MS9226-04

EXPENDABLE ITEMS

Nomenclature	Part Number	Quantity
Gasket	Typical PN4020644	1

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains engine start procedures, overtemperature limits (engine start), and an engine leak check.

2. PRELIMINARY INSTRUCTION.

a. Perform pretest requirements in WP 100 00.

b. Review engine operating limits in WP 205 00.

c. Determine engine test requirements per WP 206 00.

d. Perform engine prestart per WP 207 00.

e. Review ground safety precautions in WP 208 00.

f. Review emergency procedures in WP 209 00.

3. ENGINE START.

a. Review engine inlet icing conditions/criteria per paragraph 4.

b. Start engine in PRIMARY mode per paragraph 5.

c. Start engine in SECONDARY mode per paragraph 6.

d. Perform preserved engine start per paragraph 7.

4. ENGINE ICING DURING TEST RUN.

CAUTION

Icing may occur when humidity is high and air inlet total temperature (T_{t2})is below 45°F (7°C).

a. Shut down engine if either of the following conditions exists:

(1) Ice forms on inlet screen.

NOTE

Special engine operating procedures with anti-ice valve open (ON) are described in step c.

b. Potential icing conditions:

(1) T_{t2} is below 45°F (7°C), with precipitation, such as rain, sleet, snow, or fog.

(2) T_{t2} is between 45°F (7°C) and 36°F (2°C), with dew point temperature within 5°F (3°C) of T_{t2} .

c. If potential icing exists, as in step b, do the following:

(1) Turn ANTI-ICE ON.

(2) Monitor test stand bellmouth screen for ice accumulation.

5. ENGINE START - PRIMARY MODE.
(See Tables 1 and 3.)

Table 1. Engine Start - Primary Mode

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
	NOTE • For initial start of preserved engine or first start after fuel system maintenance, start engine per table 3. Fuel system maintenance is maintenance that disconnects or replaces fuel system lines or components. • If this is first start after extensive aircraft/engine maintenance, seals may have shrunk and engine leakage may exceed limits. Run engine at IDLE for five minutes to seat seals, then reinspect.		
1.	Move throttle to CUTOFF.		
2.	Engage FAC FUEL OPEN and CELL FUEL OPEN push button switches.	a. Pfo is to 65 psig.	a.1. Adjust test cell fuel control valve. a.2. Troubleshoot Pfo reading using a different gage connected to MFP inlet Pfo port.
		b. External engine leakage within limits of WP 205 00.	

Table 1. Engine Start - Primary Mode (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
3.	Turn Mn simulator POWER ON and adjust octal reading to 0214.	ON light illuminates. 0214 displayed.	Repair or replace Mn simulator.
4.	Turn IDLE NOZZLE POSITION to reset.	IDLE NOZZLE POSITION light extinguishes.	Repair or replace Mn simulator.
5.	Turn GROUND IDLE THRUST ON.	Light illuminates.	Check test cell wiring and power supply.

CAUTION

- Ice accumulation on bellmouth screen can damage engine. If potential icing condition exist (see paragraph 4) use engine anti-ice air at all times except when specifically instructed otherwise. Frequently observe bellmouth for ice accumulation and shut down engine if ice forms on inlet screen.
- If core run-in is to be performed and anti-ice valve is removed, do not start engine if potential icing conditions exist.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
6.	If potential icing conditions exist, turn ANTI-ICE ON.	Amber light illuminates.	Check test cell wiring and power supply.
6a.	If potential icing conditions do not exist, turn ANTI-ICE OFF.	Green light illuminates.	Check test cell wiring and power supply.
7.	Turn EHR/EDU POWER ON.	a. Light illuminates. b. EDU READY light illuminates within 2 seconds.	a. Troubleshoot test cell wiring and power supply. b. Troubleshoot EDU and EDU power.
8.	Turn PRIMARY Mode ON.	PRIMARY Mode light illuminates.	Troubleshoot test cell wiring and power supply.
9.	Turn aircraft identifier to appropriate position.		
	a. F-15 - For engines installed in F-15s.	a. F-15 light illuminates.	a. Troubleshoot test cell.
	b. F-16 - For engines installed in F-16s.	b. F-16 light illuminates.	b. Troubleshoot test cell.

Table 1. Engine Start - Primary Mode (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
10.	Turn engine identifier switch to 220/229.	EEC OFF light extinguishes.	Troubleshoot test cell.
11.	Turn right IGN INHIBIT OFF.	Right IGN INHIBIT light extinguishes.	Troubleshoot test cell.
12.	Turn left IGN INHIBIT switch OFF:	Left IGN INHIBIT light extinguishes.	Troubleshoot test cell.
	a.Turn right AUG IGNITION INHIBIT switch OFF.	a. Right AUG IGNITION INHIBIT light extinguishes.	a. Troubleshoot test cell.
	b.Turn left AUG IGNITION INHIBIT switch OFF.	b. Left AUG IGNITION INHIBIT light extinguishes.	b. Troubleshoot test cell.

NOTE

- To prevent possible engine damage, abort start and refer to emergency procedures if any of the following occur:
  - (1) FTIT increases rapidly through 1382°F (750°C) or beyond 1472°F (800°C).
  - (2) Flamming (torching) observed at exhaust nozzle.
  - (3) N_2 stable or decreases as FTIT rises.
  - (4) Audible stall occurs.
- Hung Primary Mode engine starts can result from ice formation in Pb system.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
13.	Observe and record the following during engine start:		
	a. Throttle move to ignition (FTIT rise) time.		
	b. Ignition to 8,400 N_2 rpm time.		
	c. Maximum FTIT during start cycle.		
	d. MOP 1 minute after ignition.		

Table 1. Engine Start - Primary Mode (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication

CAUTION

- If STARTER has been OFF since initial set up, verify starter coupling engagement before continuing start to prevent drive gear coupling damage.
- To prevent possible engine damage, abort start and refer to Troubleshooting Fault Isolation Check List per WP 509 00, if any of the following occurs (The following will cause either abrupt application or release of air starter torque.):
  1. Air Starter is re-engaged while engine is rotating.
  2. Starter shaft shears.
  3. Starter to gearbox coupling adapter disengages during start.
  4. Starter hose blows off.
  5. Gearbox coupling shears.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
14.	Check ENGINE START switch is ON.	ENGINE START light illuminates.	Troubleshoot test cell.
15.	Turn START AIR ON.	Engine rotates.	Check starter coupling engagement.
16.	Observe N_1 and N_2.	N_2 rpm and then N_1 rpm begin to increase.	If N_2 or N_1 rpm does not increase, perform engine rotation inspection.

Table 1. Engine Start - Primary Mode (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
CAUTION: Advancing throttle above CUTOFF before FTIT is below specified temperature may result in engine hot start and/or turbine damage.			
17.	Motor engine 2,520 to 2,940 N_2 rpm. Advance throttle to IDLE when FTIT is less than 392°F (200°C).	a. N_2 continues to increase. b. Ignition (FTIT rises) within 30 seconds. c. FTIT within limits per WP 205 00.	a. Troubleshoot engine air start system. b. If ignition does not occur within 30 seconds, move throttle to CUTOFF, release START AIR and turn ENGINE START OFF. Repeat start. If ignition does not occur within 30 seconds on second start, troubleshoot engine ignition system. If hot start occurs, abort start by emergency procedures. Repeat start. If hot start recurs, troubleshoot.
18.	Release START AIR when N_2 reaches 6,000 rpm.	START AIR light extinguishes.	Troubleshoot test cell.
19.	Turn ENGINE START OFF.	a. ENGINE START light extinguishes. b. FTIT within limits with N_2 rpm increasing.	a. Troubleshoot test cell. b.1. If FTIT stops rising and N_2 rpm stabilizes below 8,400, abort start by moving throttle to CUTOFF. Turn ENGINE START ON at first 2,000 or below N_2 rpm. Motor engine until FTIT is less than 392°F (200°C). Release START AIR and turn ENGINE START OFF. Repeat start. If hung start recurs, troubleshoot.

Table 1. Engine Start - Primary Mode (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
			b.2. If slow engine start occurs, verify IDLE NOZZLE POSITION is reset. Repeat start if switch was off. If switch was reset, troubleshoot. b.3. If hot start occurs (N_2 rpm stablizes or decreases below IDLE speed as FTIT increases), abort start and refer to emergency procedures. Repeat start. If hot start recurs on second attempt, troubleshoot.

CAUTION

Do not operate engine longer than one minute with zero oil pressure. Abort start attempt if positive oil pressure indication (approx. 10 psid) is not present. Reject engine for teardown inspection if engine is operated at zero oil pressure for more than one minute.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
		c. Oil pressure indication within 1 minute after engine ignition.	c. Abort start by moving throttle to CUTOFF. Troubleshoot.

WARNING

Do not enter engine test cell when engine is operating above IDLE. Wear approved double noise protection during engine operaton to avoid hearing damage.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
20.	Verify starter coupling is disengaged.	Running clearance between pawls.	Correct as required.

Table 1. Engine Start - Primary Mode (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication

CAUTION

Ice accumulation on bellmouth screen can damage engine. If potential icing conditions exist (see paragraph 4) use engine anti-ice air at all times except when specifically instructed otherwise. Frequently observe bellmouth for ice accumulation and shut down engine if ice forms on inlet screen.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
21.	Deleted.		
22.	Observe instrumentation reading for normal IDLE operation.	a. FTIT within limits per WP 205 00.	a. Troubleshoot.
		b. Oil pressure within limits per WP 205 00.	b. Troubleshoot.
		c. Vibration within limits per WP 205 00.	c. Troubleshoot.
		d. No fault lights illuminated.	d. Shut down engine and clear EDU faults. Repeat start. If faults recur, troubleshoot.

WARNING

Use caution when checking for air leakage in the anti-ice system and 13th stage air to anti-ice valve, augmentor fuel pump, convergent exhaust nozzle control, and borescope ports. Air will be hot and highly pressurized.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
23.	Inspect engine for fuel or oil leakage. (Leak test period is 5 minutes.)	Front, center, and rear overboard drain leakage within limits of per WP 205 00.	Troubleshoot as required.
24.	Perform required tests. If no further testing required, shut down engine per WP 225 00.		

6. ENGINE START - SECONDARY MODE.
(See Table 2 and 3.)

Table 2. Engine Start - Secondary Mode

Step	Procedure	Normal Indication	Remedy for Abnormal Indication

NOTE

For initial start of a preserved engine or first start after fuel system maintenance, start engine per table 3. Fuel system maintenance is maintenance that disconnects or replaces fuel system lines or components.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
1.	Move throttle to CUTOFF.		
2.	Engage FAC FUEL OPEN and CELL FUEL OPEN push button switches.	Pfo is to 65 psig.	• Adjust test cell fuel control valve. • Check Pfo reading using a different gage connected to MFP inlet Pfo port.
3.	Turn Mn Simulator POWER switch ON and adjust octal reading to 0214.	ON light illuminates. 0214 displayed.	Repair or replace Mn Simulator.
4.	Turn IDLE NOZZLE POSITION to reset.	IDLE NOZZLE POSITION light extinguishes.	Repair or replace Mn Simulator.
5.	Turn GROUND IDLE THRUST ON.	Light illuminates.	Check test cell wiring and power supply.

Table 2. Engine Start - Secondary Mode (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication

CAUTION

- Ice accumulation on bellmouth screen can damage engine. If potential icing conditions exist (see paragraph 4) use engine anti-ice air at all times except when specifically instructed otherwise. Frequently observe bellmouth for ice accumulation and shut down engine if ice forms on inlet screen.
- If core run-in is to be performed and anti-ice valve is removed, do not start engine if potential icing conditions exist.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
6.	If potential icing conditions exist, turn ANTI-ICE ON.	Amber light illuminates.	Check test cell wiring and power supply.
6a.	If potential icing conditions do not exist, turn ANTI-ICE OFF.	Green light illuminates.	Check test cell wiring and power supply.
7.	Turn EHR/EDU POWER ON.	a. Light illuminates.	a. Check test cell wiring and power supply.
		b. EDU READY light illuminates within 2 seconds.	b. Check EDU and EDU power.
8.	Turn SECONDARY Mode ON.	SECONDARY Mode light illuminates.	Check test cell wiring and power supply.
9.	Turn aircraft identifier to appropriate position.		
	a. F-15 - For engines installed in F-15s.	a. F-15 light illuminates.	a. Troubleshoot test cell.
	b. F-16 - For engines installed in F-16s.	b. F-16 light illuminates.	b. Troubleshoot test cell.

Table 2. Engine Start - Secondary Mode (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
10.	Turn engine identifier to 220/229.	EEC OFF light extinguishes.	Troubleshoot test cell.
11.	Turn right IGN INHIBIT OFF.	Right IGN INHIBIT light extinguishes.	Troubleshoot test cell.
12.	Turn left IGN INHIBIT OFF:	Left IGN INHIBIT light extinguishes.	Troubleshoot test cell.
	12a.Turn right AUG IGNITION INHIBIT switch OFF.	a. Right AUG IGNITION INHIBIT light extinguishes.	a. Troubleshoot test cell.
	12b.Turn left AUG IGNITION INHIBIT switch OFF.	b. Left AUG IGNITION INHIBIT light extinguishes.	b. Troubleshoot test cell.

NOTE

Abort start and refer to emergency procedures if any of following conditions occur:

- FTIT increases rapidly through 1382°F (750°C) or beyond 1472°F (800°C).
- Flaming (torching) observed at exhaust nozzle.
- N_2 stable or decreases as FTIT rises.
- Audible stall occurs.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
13.	Observe and record the following during engine start: a. Throttle move to ignition (FTIT rise) time.		

Table 2. Engine Start - Secondary Mode (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
13.	(continued) b. Ignition to 8,400 N_2 rpm time. c. Maximum FTIT during start cycle. d. MOP 1 minute after ignition.		

CAUTION

If STARTER has been OFF since initial set up, verify starter coupling engagement before continuing start to prevent drive gear coupling damage.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
14.	Check ENGINE START switch is ON.	ENGINE START light illuminates.	Troubleshoot test cell.
15.	Hold START AIR ON.	Engine rotates.	Check starter coupling engagement.
16.	Observe N_1 and N_2.	N_2 rpm and then N_1 rpm begin to increase.	If N_2 or N_1 rpm does not increase, perform engine rotation inspection.

CAUTION

Advancing throttle above CUTOFF before FTIT is below specified temperature may result in engine hot start and/or turbine damage.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
17.	Motor engine to at least 2,940 N_2 rpm. Advance throttle to IDLE when FTIT is less than 392°F (200°C).	a. N_2 above 2,940 rpm. b. Ignition (FTIT rises) within 30 seconds.	a. Troubleshoot engine air starter. b. If ignition does not occur within 30 seconds, move throttle to CUTOFF, release START AIR and turn ENGINE START. Repeat start. If ignition does not occur within 30 seconds on second start, troubleshoot engine ignition system.

Table 2. Engine Start - Secondary Mode (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
		c. FTIT within limits of WP 205 00.	c. If hot start occurs, abort start by emergency procedures. Reattempt start. If hot start recurs, troubleshoot.
18.	Release START AIR when N_2 reaches 6000 rpm	START AIR light extinguishes.	Troubleshoot test cell.
19.	Turn ENGINE START off	a. ENGINE START light extinguishes.	a. Troubleshoot test cell.
		b. FTIT within limits with N_2 rpm increasing.	b.1. If FTIT stops rising and N_2 rpm stabilizes below 8400, abort start by moving throttle to CUTOFF. Turn ENGINE START on at first at 2000 or below N_2 rpm. Motor engine until FTIT is less than 392°F (200°C). Release START AIR and turn ENGINE START off. Repeat start. If hung start recurs, troubleshoot.
			b.2. If hot start occurs (N_2stablilizes or decreases below IDLE as FTIT increases) abort start and refer to emergency procedures. Repeat start. If hot start recurs on second start attempt, troubleshoot.

Table 2. Engine Start - Secondary Mode (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication

CAUTION

Do not operate engine longer than 1 minute with zero oil pressure. Abort start attempt if a positive oil pressure indication (approx. 10 psid) is not present. Reject engine for teardown inspection if engine is operated at zero oil pressure for more than 1 minute.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
		d. Oil pressure indication within 1 minute after engine ignition.	d. Abort start by moving throttle to CUTOFF. Troubleshoot.

WARNING

Do not enter engine test cell when engine is operating above IDLE. Wear approved double noise protection during engine operation to avoid hearing damage.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
20.	Verify starter coupling is disengaged.	Running clearance between pawls.	Correct as required.

CAUTION

Ice accumulation on bellmouth screen can damage engine. If potential icing conditions exit (see paragraph 4) use engine anti-ice air at all times except when specifically instructed otherwise. Frequently observe bellmouth for ice accumulation and shut down engine if ice forms on inlet screen.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
21.	Deleted.		

Table 2. Engine Start - Secondary Mode (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
22.	Observe instrumentation reading for normal IDLE operation.	a. FTIT within limits of WP 205 00.	a. Troubleshoot.
		b. Oil pressure within limits of WP 205 00.	b. Troubleshoot.
		c. Vibration within limits of WP 205 00.	c. Troubleshoot.
		d. No fault lights illuminated.	d. Shut down engine and clear EDU faults. Repeat start. If faults recur, troubleshoot.

WARNING

Use caution when checking for air leakage in anti-ice system, and 13th stage air to anti-ice valve augmentor fuel pump, convergent exhaust nozzle control, and borescope ports. Air will be hot and highly pressurized.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
23.	Inspect engine for fuel or oil leakage. (Leak test period is 5 minutes.)	Front, center and rear overboard drain leakage within limits of WP 205 00.	Troubleshoot.
24.	Perform required tests. If no further test required, shut down engine per WP 225 00.		

7. ENGINE START - PRESERVED ENGINES OR AFTER FUEL SYSTEM MAINTENANCE.
(See Table 3.)

Table 3. Engine Start - Preserved Engine Or After Fuel System Maintenance

Step	Procedure	Normal Indication	Remedy for Abnormal Indication

NOTE

Use this procedures only for initial start of preserved engine or initial start after engine fuel system maintenance. Fuel system maintenance is maintenance that disconnects or replaces fuel system lines or components.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
1.	Move throttle to CUTOFF.		
2.	a. Engage FAC FUEL OPEN and CELL FUEL OPEN push button switches.	a. Pfo is to 65 psig.	a.1. Adjust test cell fuel control valve. a.2. Troubleshoot Pfo reading using a different gage connected to the MFP inlet Pfo port.
		b. External engine leakage within limits.	b. Troubleshoot.
3.	Turn Mn Simulator POWER ON and adjust octal to 0214.	ON illuminates. 0214 displayed.	Repair or replace Mn Simulator.
4.	Turn IDLE NOZZLE POSITION to reset position.	IDLE NOZZLE POSITION light extinguishes.	Repair or replace Mn Simulator.
5.	Turn GROUND IDLE THRUST ON.	Light illuminates.	Check test cell wiring and power supply.

CAUTION

- Ice accumulation on bellmouth screen can damage engine. If potential icing conditions exist (see paragraph 4) use engine anti-ice air at all times except when specifically instructed otherwise. Frequently observe bellmouth for ice accumulation and shut down engine if ice forms on inlet screen.

- If core run-in is to be performed and anti-ice valve is removed, do not start engine if potential icing conditions exist.

Table 3. Engine Start - Preserved Engine Or After Fuel System Maintenance (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
6.	If potential icing conditions exist, turn ANTI-ICE ON.	Amber light illuminates.	Troubleshoot test cell wiring and power supply.
6a.	If potential icing conditions do not exist, turn ANTI-ICE OFF.	Green light illuminates.	Troubleshoot test cell wiring and power supply.
7.	Turn EHR/EDU POWER ON.	a. Light illuminates.	a. Troubleshoot test cell wiring and power supply.
		b. EDU READY light illuminates with 2 seconds.	b. Troubleshoot EDU and EDU power
8.	Turn PRIMARY Mode to ON.	PRIMARY Mode light illuminates.	Troubleshoot test cell wiring and power supply.
9.	Turn aircraft identifier to appropriate position:		
	a. F-15 - For engines installed in F-15s.	a. F-15 light illuminates.	a. Troubleshoot test cell.
	b. F-16 - For engines installed in F-16s.	b. F-16 light illuminates.	b. Troubleshoot test cell.
10.	Turn engine identifier to 220/229.	EEC OFF light extinguishes.	Troubleshoot test cell.
11.	Turn right IGN INHIBIT OFF.	Right IGN INHIBIT light extinguishes.	Troubleshoot test cell.
12.	Turn left IGN INHIBIT OFF:	Left IGN INHIBIT light extinguishes.	Troubleshoot test cell.
	a. Turn right AUG IGNITION INHIBIT switch OFF.	a. Right AUG IGNITION INHIBIT light extinguishes.	a. Troubleshoot test cell.
	b. Turn left AUG IGNITION INHIBIT switch OFF.	b. Left AUG IGNITION INHIBIT light extinguishes.	b. Troubleshoot test cell.

Table 3. Engine Start - Preserved Engine Or After Fuel System Maintenance (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication

CAUTION

Abort start and refer to emergency procedures if any of the following occur:

- FTIT increases rapidly through 1382°F (750°C) or beyond 1472°F (800°C).
- Flamming (torching) is observed at exhaust nozzle.
- N_2 stable or decreases as FTIT rises.
- Audible stall occurs.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
13.	Observe and record following during engine start: a. Throttle move to ignition (FTIT rise) time. b. Ignition to 8,400 N_2 rpm time. c. Maximum FTIT during start cycle. d. MOP 1 minute after ignition.		

CAUTION

If STARTER has been turned OFF since initial set up, verify starter coupling engagement before continuing engine start to prevent drive gear coupling damage.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
14.	Check ENGINE START switch is ON.	ENGINE START light illuminates.	Troubleshoot test cell.
15.	Hold START AIR ON.	Engine rotates.	Check starter coupling engagement.
16.	Observe N_1 and N_2.	N_2 rpm and then N_1 rpm begin to increase	If N_2 or N_1 rpm does not increase, perform engine rotation inspection.
17.	Motor engine to maximum N_2 rpm.	N_2 is above 2,940 rpm.	Troubleshoot engine air start system.

Table 3. Engine Start - Preserved Engine Or After Fuel System Maintenance (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication

CAUTION

Advancing throttle above CUTOFF before FTIT is below specified temperature may result in engine hot start and/or turbine damage.

NOTE

- On engines being started for first time since preservation, white oil vapor will appear from exhaust for several seconds. This condition is normal.
- On engines being started for first time since fuel system maintenance, preservation, or engine assembly, open-loop system faults may occur. If fault occurs during start, continue start. Shut down and clear faults after engine leak check.
- If exhaust nozzle closes during start, engine has automatically transferred to SECONDARY mode. In SECONDARY mode, engine will accelerate to IDLE slower. If FTIT remains below 1472°F (800°C), continue start. Engine can be transferred to PRIMARY mode after engine reaches IDLE. If engine cannot be transferred to PRIMARY mode, shut down engine and clear faults and perform PRIMARY mode start.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
18.	Move throttle to IDLE when FTIT is less than 392°F (200°C). Check for first indication of ignition (FTIT increases).	a. Ignition within 10 seconds.	a.1. If ignition does not occur within 10 seconds, move throttle to CUTOFF. a.2. Immediately move throttle to IDLE. a.3. If ignition (FTIT increases) still does not occur within 20 seconds: • Move throttle to CUTOFF. • Continue to motor engine for 30 seconds. • Discontinue start. • Perform engine start after starter cools.

Table 3. Engine Start - Preserved Engine Or After Fuel System Maintenance (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
		b. FTIT within limits of WP 205 00.	b. If hot start occurs, abort start by moving throttle to CUTOFF. Motor engine until FTIT is less than 392°F (200°C). Release START AIR switch and turn ENGINE START off. Repeat start attempt after starter cools. If hot start recurs, troubleshoot.
19.	Release START AIR switch when N_2 reaches 6000 rpm	START AIR light extinguishes.	Troubleshoot test cell.
20.	Turn ENGINE START off.	a. ENGINE START light extinguishes. b. FTIT within limits with N_2 rpm increasing.	a. Troubleshoot test stand. b.1. If FTIT stops rising and N_2 rpm stabilizes below 8400, abort start by moving throttle to CUTOFF. Turn ENGINE START on at 2000 or below N_2rpm. Motor engine until FTIT is less than 392°F (200°C). Release START AIR and turn ENGINE START off. Repeat start. If hung start recurs, troubleshoot. b.2. If slow engine start occurs, verify IDLE NOZZLE POSITION is reset. Repeat start if switch was off. If switch was reset, troubleshoot.

Table 3. Engine Start - Preserved Engine Or After Fuel System Maintenance (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
			b.3. If hot start occurs (N_2 rpm stablizes or decreases below IDLE speed as FTIT increases), abort start and refer to emergency procedures. Repeat start. If hot start recurs on second start attempt, troubleshoot.

CAUTION

Do not operate engine longer than one minute with zero oil pressure. Abort start attempt if positive oil pressure indication (approx. 10 psid) is not present. Reject engine for teardown inspection if engine is operated at zero oil pressure for more than one minute.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
		d. Oil pressure indication within 1 minute after engine ignition.	d. Abort start by moving throttle to CUTOFF. Troubleshoot.

Table 3. Engine Start - Preserved Engine Or After Fuel System Maintenance (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication

WARNING

Do not enter engine test cell when engine is operating above IDLE. Wear approved noise protection during engine operation to avoid hearing damage.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
21.	Verify starter coupling is disengaged.	Running clearance between pawls.	Correct as required.

CAUTION

Ice accumulation on bellmouth screen can damage engine. If potential icing conditions exist (see paragraph 4) use engine anti-ice air at all times except when specifically instructed otherwise. Frequently observe bellmouth for ice accumulation and shut down engine if ice forms on inlet screen.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
22.	Deleted.		
23.	Observe instrumentation reading for normal IDLE engine operation.	a. FTIT within limits per WP 205 00.	a. Troubleshoot.
		b. Oil pressure within limits per WP 205 00.	b. Troubleshoot.
		c. Vibration within limits per WP 205 00.	c. Troubleshoot.
		d. No fault lights illuminated.	d. Shut down engine and clear EDU faults. Repeat start. If faults recur, troubleshoot.

Table 3. Engine Start - Preserved Engine Or After Fuel System Maintenance (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication

WARNING

Use caution when checking air leakage in anti-ice system, and 13th stage air to anti-ice valve, augmentor fuel pump, convergent exhaust nozzle control, and borescope ports. Air will be hot and highly pressurized.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
24.	Inspect engine for fuel or oil leakage. (Leak test period is 5 minutes.	Front, center, and rear overboard drain leakage are within limits of WP 205 00.	Troubleshoot.
25.	Perform required tests. If no further testing required, shut down engine per WP 225 00.		

8. FOLLOW-ON MAINTENANCE.

a. After completion of an engine start, continue engine test as specified in Engine Test Requirements, WP 206 00.

WORK PACKAGE

TECHNICAL PROCEDURES

CORE RUN-IN

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 22

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	26	6 - 7	26	15	26
2	10	8	10	16 Added	10
3 - 4	26	9	26	17 - 18	18
5	10	10 - 14 Added	10	19 - 22 Added	18

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Final Engine Dress	WP 006 00
Engine Pretest Procedure	WP 100 00
Engine Oil Servicing Procedure	WP 109 00
Engine Operating Limits	WP 205 00
Engine Test Requirements	WP 206 00
Engine Prestart	WP 207 00
Ground Safety Procedures	WP 208 00
Emergency Procedures	WP 209 00
Engine Start Procedures	WP 210 00
Engine Acceptance Test	WP 212 00
Engine Vibration Analysis	WP 218 00
Engine Shutdown	WP 225 00
Test Tooling Removal From Engine (Undress)	WP 401 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T.O. No.	Date	Level	Title (ECP No.)
T.O. 6J3-4-117-513	8 Mar 94	O/I	Upgrade of Digital Electronic Control (DEEC) PN 796521H04D04 to 2.6.2A Logic, F100-PW-229 Engine, F-15, Acft (ECP 93QA389).

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains procedures for core run-in and turbine run-in tests.

b. Core run-in test is required to be performed on engines incorporating new or refurbished core modules.

(1) A new core module is defined as having zero time/cycles since new or depot overhaul.

(2) A refurbished core module is defined as follows:

- Module in which any compressor abradable rub strips, or any compressor blade tip abradable rub strips have been replaced.
- Module in which compressor case halves have been replaced.
- Module formed by mating zero time since new or depot overhaul high pressure compressor to a unrefurbished high pressure turbine.

c. Turbine run-in test is required for engines incorporating new or refurbished High Pressure Turbines (HPTs) with new second stage turbine duct segments.

(1) A new HPT module is defined as one having zero time/ cycles.

(2) A refurbished HPT is defined as one in which first or second turbine blades have been replaced or one in which first stage turbine vane and duct support has been replaced.

d. A turbine run-in is not required if a core run-in will be performed because core run-in adequately runs-in turbine.

2. PRELIMINARY INSTRUCTIONS.

a. Perform pretest requirements in WP 100 00.

b. Review engine operating limits in WP 205 00.

c. Determine engine test requirements per WP 206 00.

d. Perform engine prestart per WP 207 00.

e. Review ground safety procedures in WP 208 00.

f. Review emergency procedures in WP 209 00.

g. Review engine icing during test run procedures in WP 210 00.

h. If core run-in is required, perform procedures of paragraph 3 and Table 1; if turbine run-in is required, perform procedures of paragraph 4, Table 2.

3. CORE RUN-IN TEST (COMPRESSOR AND TURBINE RUN-IN TESTS).
(See Table 1 and Figure 1.)

a. Determine if core run-in test is required per WP 206 00.

NOTE

- If potential icing conditions exist, and anti-icing valve is removed, testing shall be discontinued until icing conditions no longer exist.
- If potential icing conditions exist and anti-icing valve has not been removed, engine anti-icing air shall be used at all times, except when specifically instructed otherwise.
- Bellmouth shall be observed frequently for ice accumulation and engine is shut down if ice forms on inlet screen, or ΔP screen value is not within limits.

b. Ensure anti-ice blank-off plates are installed per WP 006 00, if required.

NOTE

- If engine is shutdown for any reason before completion of core run-in procedures, temporary N2 rotor seizure may occur.
- If rotor seizure occurs, seizure is not detrimental to engine, rotor will free as engine thermally equalizes (typically less than 2 hours).
- Further engine inspection and disassembly is not required when seizure clears.

c. EDU faults during core run-in.

(1) Anti-ice faults can occur if anti-ice valve is disconnected. Faults may be cleared from EDU (reset) without further maintenance if anti-ice valve is removed for core run-in.

(2) If anti-ice valve is removed and anti-ice faults occur, perform the following:

(a) Clear EDU faults when core run-in is completed.

(b) Functionally check anti-ice valve during acceptance test.

(3) Fault Code 1120 (No Start event), will be recorded during step 2., table 1. This fault may be cleared from EDU without further maintenance before starting engine in step 3., table 1.

Table 1. Core Run-In

Step	Procedure	Normal Indication	Remedy for Abnormal Indication

NOTE

Core Run-In procedures require operator to snap to specific PLA settings. Mark PLA settings on throttle quadrant prior to engine start.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
1.	Perform CEDS DEEC STATIC MONITOR per WP 653 00. Advance throttle and mark PLA settings 40°, 56°, 71°, 77°, and 91° on throttle quadrant		

CAUTION

Ice accumulation on bellmouth screen can damage engine.

NOTE

- Target variation in PLA setting is ± 5 degrees from specified value, unless otherwise stated.
- Target variation in stated stabilization times is +10/–0 seconds for stabilizations of 10 seconds or greater. When stabilizations of less than 10 seconds are specified, target variation is +3/–0 seconds.
- Do not perform 5 minute Idle run for oil servicing. Follow procedure per WP 109 00 for core run-in oil servicing. This procedure requires engine motoring to check oil level before core run-in and oil servicing after completion of core run-in.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
2.	Start engine in PRIMARY MODE using Preserved Engine Start Procedures per WP 210 00. When N2 reaches a value of 8,500 rpm, abort start by moving throttle to CUTOFF.		

Table 1A. Core Run-In (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication

CAUTION

To prevent compressor blade tip fractures, Shut Down engine if specified times are exceeded by 5 seconds between steps 3 and 30.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
3.	Perform PRIMARY MODE start per WP 210 00, Table 1.		

NOTE

- If excess leakage is noted, shut down engine and troubleshoot as required. If engine is shutdown, begin again with a PRIMARY MODE start step 3.
- If main oil temperature has not reached 100°F (38°C), remain at IDLE until temperature is reached.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
4.	Stabilize 2 minutes (120 seconds) at IDLE. Inspect engine for fuel or oil leakage during 2 minutes (120 seconds) stabilization.		
5.	After 1 minute (60 seconds) dwell at GROUND IDLE, check operation and record in figure 1.	a. N_1C_2 within limits. (4,025 to 4,225 rpm)	a. Troubleshoot Idle speed out of limits per WP 514 00.
		b. ENP above 80%	b. Troubleshoot ENP out of limits per WP 513 00.
6.	Snap to 56 degrees PLA.Stabilize 3 seconds.		
7.	Snap to IDLE PLA.Stabilize 120 seconds.		
8.	Snap to 56 degrees PLA.Stabilize 3 seconds.		

Table 1B. Core Run-In (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
9.	Snap to IDLE PLA.Stabilize 30 seconds.		
10.	Snap to 56 degrees PLA.Stabilize 3 seconds.		
11.	Snap to IDLE PLA.Stabilize 30 seconds.		
12.	Snap to 56 degrees PLA.Stabilize 3 seconds.		
13.	Snap to IDLE PLA.Stabilize 30 seconds.		
14.	Snap to 56 degrees PLA.Stabilize 3 seconds.		
15.	Snap to IDLE PLA.Stabilize 30 seconds.		
16.	Snap to 56 degrees PLA.Stabilize 3 seconds.		
17.	Snap to IDLE PLA.Stabilize 30 seconds.		
18.	Snap to 56 degrees PLA.Stabilize 3 seconds.		
19.	Snap to IDLE PLA.Stabilize 40 seconds.		
20.	Snap to 56 degrees PLA.Stabilize 3 seconds.		
20.a.	Snap to IDLE PLA.Stabilize 40 seconds.		
20.b.	Snap to 56 degrees PLA.Stabilize 3 seconds.		

Table 1. Core Run-In (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
NOTE •If vibrations are out of limits during Intermediate (MIL) check in step 21., record rpm at highest VICV, VDCH, VAP6 and VGBV. Shut down engine per WP 225 00 and troubleshoot vibration equipment. After troubleshooting completed, start engine per step 3. If vibrations repeat out of limits condition, troubleshoot per WP 218 00. If engine passes vibration analysis, complete core run-in staring with step 3.			
21.	Perform slow acceleration (20 to 30 seconds) to Intermediate (MIL) PLA.	Vibrations within limits per WP 205 00.	Troubleshoot vibration out of limits per WP 218 00.
22.	Stabilize for 10 seconds.	Engine parameters within limits.	Troubleshoot engine parameters out of limits per WP 205 00.
23.	Snap to IDLE PLA.Stabilize 20 seconds.		
24.	Snap to 71 degrees PLA.Stabilize 3 seconds.		
25.	Snap to IDLE PLA.Stabilize 20 seconds.		
26.	Snap to 71 degrees PLA.Stabilize 3 seconds.		
27.	Snap to IDLE PLA.Stabilize 20 seconds.		
28.	Snap to 71 degrees PLA.Stabilize 3 seconds.		
29.	Snap to IDLE PLA.Stabilize 20 seconds.		
30.	Snap to 71 degrees PLA.Stabilize 3 seconds.		

Table 1D. Core Run-In (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
31.	Snap to IDLE PLA.		
32.	If anti-icing valve is installed, cycle anti-icing valve from CLOSED to OPEN to CLOSED two times.	Increase in FTIT, N2 rpm, and VICV should be indicated.	Troubleshoot anti-icing valve per WP 517 00. EDU Faults WP 627 01

CAUTION

If Off Idle stabilization times after step 33 will be exceeded by more than 10 seconds, retard throttle to idle, stablize 10 minutes (600 seconds) and return to step 33. Failure to retard throttle to idle can result in compressor blade tip fractures.

NOTE

If engine is shut down after step 32, perform PRIMARY MODE start per WP 210 00, Table 1. Stabilize at IDLE PLA for 12 minutes (720 seconds) before performing step 33.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
33.	Turn IDLE exhaust nozzle OFF.	a. ENP closes to less than 20% and N1 rpm speed increases. b. N_1C_2 increases.	a. Troubleshoot ENP out of limits per WP 513 00. b. Troubleshoot IDLE speed out of limits per WP 514 00.
34.	Turn IDLE exhaust nozzle to RESET.	ENP opens to above 80%.	Troubleshoot ENP out of limits per WP 513 00.
35.	Stabilize at IDLE PLA for 15 minutes.		
36.	Snap to 40 degrees PLA.Stabilize for 2 seconds.		
37.	Snap to IDLE PLA.Stabilize for 30 seconds.		

Table 1. Core Run-In (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
38.	Snap to 56 degrees PLA.Stabilize for 3 seconds.		
39.	Snap to IDLE PLA.Stabilize for 30 seconds.		
40.	Snap to 71 degrees PLA.Stabilize for 3 seconds.		
41.	Snap to IDLE PLA.Stabilize for 30 seconds.		
42.	Snap to 77 degrees PLA.Stabilize for 4 seconds.		
43.	Snap to 56 degrees PLA.Stabilize for 30 seconds.		
44.	Snap to 77 degrees PLA.Stabilize for 2 seconds.		
45.	Snap to IDLE PLA.Stabilize for 25 seconds.		
46.	Snap to 56 degrees PLA.Stabilize for 3 seconds.		
47.	Snap to IDLE PLA.Stabilize for 30 seconds.		
48.	Snap to 56 degrees PLA.Stabilize for 3 seconds.		
49.	Snap to IDLE PLA.Stabilize for 30 seconds.		

Table 1. Core Run-In (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
50.	Snap to 77 degrees PLA.Stabilize for 4 seconds.		
51.	Snap to 56 degrees PLA.Stabilize for 30 seconds.		
52.	Snap to 77 degrees PLA.Stabilize for 2 seconds.		
53.	Snap to IDLE PLA.Stabilize for 30 seconds.		
54.	Snap to 77 degrees PLA.Stabilize for 4 seconds.		
55.	Snap to 56 degrees PLA.Stabilize for 30 seconds.		
56.	Snap to 77 degrees PLA.Stabilize for 2 seconds.		
57.	Snap to IDLE PLA.Stabilize for 30 seconds.		
58.	Snap to 77 degrees PLA.Stabilize for 4 seconds.		
59.	Snap to 71 degrees PLA.Stabilize for 30 seconds.		
60.	Snap to 77 degrees PLA.Stabilize for 2 seconds.		

Table 1. Core Run-In (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
61.	Snap to IDLE PLA.Stabilize for 30 seconds.		
62.	Snap to 77 degrees PLA.Stabilize for 4 seconds.		
63.	Snap to 71 degrees PLA.Stabilize for 30 seconds.		
64.	Snap to 77 degrees PLA.Stabilize for 2 seconds.		
65.	Snap to IDLE PLA.Stabilize for 30 seconds.		
66.	Snap to Intermediate (MIL) PLA.Stabilize for 5 seconds.		
67.	Snap to 77 degrees PLA.Stabilize for 30 seconds.		
68.	Snap to Intermediate (MIL) PLA.Stabilize for 2 seconds.		
69.	Snap to IDLE PLA.Stabilize for 30 seconds.		
70.	Snap to Intermediate (MIL) PLA.Stabilize for 5 seconds.		
71.	Snap to 77 degrees PLA.Stabilize for 30 seconds.		

Table 1. Core Run-In (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
72.	Snap to Intermediate (MIL) PLA.Stabilize for 2 seconds.		
73.	Snap to IDLE PLA.Stabilize for 1 minute (60 seconds).		
74.	Snap to Intermediate (MIL) PLA.Stabilize for 5 seconds.		
75.	Snap to 77 degrees PLA.Stabilize for 1 minute and 20 seconds (80 seconds).		
76.	Snap to Intermediate (MIL) PLA.Stabilize for 2 seconds.		
77.	Snap to IDLE PLA.Stabilize for 1 1/2 minutes (90 seconds).		
78.	Snap to Intermediate (MIL) PLA.Stabilize for 5 seconds.		
79.	Snap to 77 degrees PLA.Stabilize for 2 1/2 minutes (150 seconds).		
80.	Snap to Intermediate (MIL) PLA.Stabilize for 2 seconds.		

Table 1. Core Run-In (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
81.	Snap to IDLE PLA.Stabilize for 2 minutes (120 seconds).		
82.	Snap to Intermediate (MIL) PLA.Stabilize for 5 seconds.		
83.	Snap to 77 degrees PLA. After 60 second dwell, record data in figure 1. Stabilize 3 minutes (180 seconds).		
84.	Perform slow acceleration (20 to 30 seconds) to 91 degrees PLA.	Vibrations within limits per WP 205 00.	Troubleshoot vibration out of limits per WP 218 00.
85.	Stabilize for 5 seconds.	Engine parameters within limits.	Troubleshoot engine parameters out of limits per WP 205 00.
86.	Snap to 77 degrees PLA.Stabilize 1 minute (60 seconds).		
87.	Snap to 91 degrees PLA.Stabilize for 2 seconds.		
88.	Snap to IDLE PLA.Stabilize for 1 minute (60 seconds).		
89.	Snap to 91 degrees PLA.Stabilize for 5 seconds.		
90.	Snap to 77 degrees PLA.Stabilize 2 minutes (120 seconds).		

Table 1K. Core Run-In (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
91.	Snap to 91 degrees PLA.Stabilize for 2 seconds.		
92.	Snap to IDLE PLA. Stabilize for 5 minutes (300 seconds).		
93.	Snap to 91 degrees PLA.Stabilize for 5 seconds.		
94.	Snap to 77 degrees PLA.Stabilize for 30 seconds.		
95.	Snap to IDLE PLA. Stabilize for 1 minute (60 seconds).		
96.	Perform slow acceleration to 56 degrees PLA. After 1 minute (60 seconds) dwell, record data in figure 1.		
97.	Perform slow acceleration to Intermediate (MIL). After 1 minute (60 seconds) dwell, record data in figure 1.		
98.	Snap to IDLE PLA.		
99.	If anti-icing valve is installed, cycle anti-icing valve from CLOSED to OPEN to CLOSED two times.	Increase in FTIT, N2 rpm, and VICV should be indicated.	Troubleshoot anti-icing valve per WP 517 00. EDU Faults WP 627 01.

Table 1. Core Run-In (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication

CAUTION

Do not shut down engine using main fuel switch/handle except for emergency. Shutdown by use of main fuel switch/handle can lead to cavitation of main fuel pump and possible damage.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
100.	Shut down engine per WP 225 00.		
101.	Remove anti-icing manifold and air inlet manifold blank-off plates per WP 401 00		

CAUTION

Debris accumulated in air inlet manifold can damage anti-icing valve. Ensure manifold is free of residue before installing valve.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
102.	Remove residue from air inlet manifold.		
103.	Install anti-icing valve per WP 401 00.		
104.	Perform engine acceptance test per WP 212 00.		

F100-PW-229 CORE RUN-IN DATA SHEET								
	N1	N2	FTIT	ENP	MOP	VICV	VDCH	VAP6
IDLE (GROUND) (Step 5)								
77 PLA (Step 83)								
56 PLA (Step 96)								
INTERMEDIATE (MIL) (Step 97)								

F100-PW-229 Core Run-in Data Sheet

NOTE

If anti-ice system is blanked off, anti-ice system fault codes may occur. These faults can be reset without further maintenance.

d. If System Fault Codes 4250, 4251, or 4252 (Anti-Ice Valve Failed Closed) occur, perform the following:

(1) After core run-in is completed, clear EDU per WP 656 00.

(2) Remove blank-off plates.

(3) Ensure anti-ice valve and air supply manifold are free of debris.

(4) Reinstall anti-ice valve, using new valve and manifold gaskets, per WP 401 00.

(5) Perform anti-ice valve check during acceptance test.

4. TURBINE RUN-IN TEST.

(See Table 2 and Figure 2.)

Table 2. Turbine Run-in

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
	NOTE Turbine run-in procedures require operator to snap PLA to specific settings. PLA settings shall be marked on throttle quadrant prior to engine start.		
1.	Perform CEDS DEEC Static Monitor per PW 653 00. Advance throttle and mark PLA settings on throttle quadrant as follows: 40 degrees, 56 degrees, 71 degrees, 77 degrees, and 91 degrees.		
	NOTE • Target variation in PLA setting is ±5 degrees from stated value. • Target variation in stated stabilization time +10/-0 seconds for stabilization of 10 seconds or greater. Target variation is +3/-0 seconds for stabilization of less than 10 seconds. • This procedure requires engine motoring to check oil level before run-in and oil servicing after completion of run-in, 5 minute Idle run for oil servicing shall not be performed. Procedure for oil servicing is contained in WP 109 00.		
2.	Perform engine start in primary mode using Preserved Engine Start procedure per WP 210 00.	Engine starts normally.	Troubleshoot engine start anomaly per WP 502 00.
	NOTE If stabilization times noted after step 2. are, or will be exceeded by more than 10 seconds, throttle shall be retarded to Idle and step 3. and higher are performed to completion.		
3.	Stablilize at ground Idle for 5 minutes. After 1 minute, check engine operation and record data in figure 2.	a. N1C2 within limits (4,025 to 4,225 rpm). b. ENP above 80%.	a. Troubleshoot Idle speed out of limits per WP 514 00. b. Troubleshoot ENP out of limits per WP 513 00.

Table 2. Turbine Run-in (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication

NOTE

If vibrations are out of limits during Intermediate (MIL) check in step 4.:

- Highest level of VICV, VDCH, VAP6, and VGBV are recorded.
- Engine shall be shut down per WP 025 00 and troubleshooting procedures performed per WP 544 00.
- Engine operating time above Idle power setting shall be minimized.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
4.	Perform slow acceleration (30 seconds) to MIL power. Monitor engine vibrations and MOP.	a. Vibrations within limits per WP 205 00.	a. Shut down engine per WP 225 00. Troubleshoot vibrations out of limits per WP 544 00.
		b. MOP increase within limits per WP 205 00.	b. Troubleshoot MOP rise out of limits per WP 531 00.
5.	Stabilize at Intermediate (MIL) power for 20 seconds maximum.		
6.	Snap to Idle PLA. Stabilize 9 minutes.		
7.	Snap to 40 degrees PLA. Stabilize 2 seconds.		
8.	Snap to Idle PLA. Stabilize 30 seconds.		
9.	Snap to 56 degrees PLA. Stabilize 3 seconds.		
10.	Snap to Idle PLA. Stabilize 30 seconds.		
11.	Snap to 71 degrees PLA. Stabilize 3 seconds.		
12.	Snap to Idle PLA. Stabilize 30 seconds.		

Table 2. Turbine Run-in (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
13.	Snap to 77 degrees PLA. Stabilize 4 seconds.		
14.	Snap to 56 degrees PLA. Stabilize 30 seconds.		
15.	Snap to Idle PLA. Stabilize 30 seconds.		
16.	Snap to 77 degrees PLA. Stabilize 4 seconds.		
17.	Snap to 56 degrees PLA. Stabilize 30 seconds.		
18.	Snap to Idle PLA. Stabilize 30 seconds.		
19.	Snap to 77 degrees PLA. Stabilize 4 seconds.		
20.	Snap to 56 degrees PLA. Stabilize 30 seconds.		
21.	Snap to Idle PLA. Stabilize 30 seconds.		
22.	Snap to 77 degrees PLA. Stabilize 4 seconds.		
23.	Snap to 71 degrees PLA. Stabilize 30 seconds.		
24.	Snap to Idle PLA. Stabilize 30 seconds.		
25.	Snap to 77 degrees PLA. Stabilize 4 seconds.		
26.	Snap to 71 degrees PLA. Stabilize 30 seconds.		

Table 2. Turbine Run-in (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
27.	Snap to Idle PLA. Stabilize 30 seconds.		
28.	Snap to MIL PLA. Stabilize 5 seconds.		
29.	Snap to 77 degrees PLA. Stabilize 30 seconds.		
30.	Snap to Idle PLA. Stabilize 30 seconds.		
31.	Snap to MIL PLA. Stabilize 5 seconds.		
32.	Snap to 77 degrees PLA. Stabilize 30 seconds.		
33.	Snap to Idle PLA. Stabilize 40 seconds.		
34.	Snap to MIL PLA. Stabilize 5 seconds.		
35.	Snap to 77 degrees PLA. Stabilize 80 seconds.		
36.	Snap to Idle PLA. Stabilize 40 seconds.		
37.	Snap to MIL PLA. Stabilize 5 seconds.		
38.	Snap to 77 degrees PLA. Stabilize 2.5 minutes (150 seconds).		
39.	Snap to Idle PLA. Stabilize 40 seconds.		
40.	Snap to MIL PLA. Stabilize 5 seconds.		

Table 2. Turbine Run-in (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
41.	Snap to 77 degrees PLA. Stabilize 3 minutes (180 seconds).		
42.	Snap to Idle PLA. Stabilize 60 seconds.		
43.	Snap to MIL PLA. Stabilize 5 seconds.		
44.	Snap to Idle PLA.		
45.	Stabilize at Idle PLA for 5 minutes (300 seconds).		
46.	Perform additional tests as required per WP 005 00.		
47.	Shut down engine per WP 025 00.		

F100-PW-229 CORE (TURBINE) RUN-IN DATA SHEET								
	N1	N2	FTIT	ENP	MOP	VICV	VDCH	VAP6
IDLE (GROUND) (Step 3)								

Figure 2. F100-PW-229 Core (Turbine) Run-in Data Sheet

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE ACCEPTANCE TEST

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 20

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	29	5	29	6B Blank Added	27
2	21	6	21	7	27
3 - 4	27	6A Added	27	8 - 18	21

REFERENCE MATERIAL REQUIRED

Title	Number
Depot Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00
Ground Safety Precautions	WP 208 00
Engine Start Procedures	WP 210 00
Engine Shutdown	WP 225 00
Engine Posttest Procedures	WP 300 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains the engine acceptance test.

2. PRELIMINARY INSTRUCTIONS.

a. Perform pretest requirements in WP 100 00.

b. Review engine operating limits in WP 205 00.

c. Determine engine test requirements per WP 206 00.

d. Perform engine prestart per WP 207 00.

e. Review ground safety procedures in WP 208 00.

f. Review emergency procedures in WP 209 00.

g. Review engine icing during test run procedures in WP 210 00.

3. ENGINE ACCEPTANCE TEST.

(See Tables 1 through 4.)

NOTE

- Reingestion of exhaust gas, under certain weather conditions is possible and may cause false rejection of serviceable engine.
- Refer to WP 208 00 for reference wind direction/ velocity limitations for open field test stand engine test.
- If reingestion of exhaust gas occurs during test, resulting in unstable check points, test shall be terminated until weather conditions allow acceptable and repeatable check points.

a. Perform engine acceptance test per table 1.

Table 1. Acceptance Test

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
A.	**Steady State Primary Mode Checks EPR/Anti-ice/ENP/ VIBS/Mn)**		
1.	Perform engine start in PRIMARY mode per WP 210 00.		
2.	Ensure engine stabilizes 5 minutes at GROUND IDLE.		
3.	Check GROUND IDLE operation. Record data reading.	a. N_1C_2 within 4025 to 4225 rpm.	a1. If N_1C_2 is above limit and Pb is 43 to 51 psia, engine operation is normal. a2. If N_1C_2 is above limit and Pb is not 43 to 51 psia, troubleshoot IDLE speed out of limits per WP 514 00. a3. If N_1C_2 is below limit, troubleshoot IDLE speed out of limits per WP 514 00.
		b. FTIT within limits per WP 205 00.	b. Troubleshoot FTIT system anomaly per WP 536 00.
		c. Vibration within limits per WP 205 00.	c. Troubleshoot vibration anomaly per WP 544 00.
		d. ENP above 80%.	d. Troubleshoot ENP anomaly per WP 513 00.
		e. MOP within limits per WP 205 00.	e. Troubleshoot MOP anomaly per WP 529 00 or WP 530 00.
		f. Breather pressure (Pmb) within limits per WP 205 00.	f. Troubleshoot breather pressure system anomaly per WP 529 00.
4.	Turn GROUND IDLE switch OFF.	Light extinguishes.	

Table 1. Acceptance Test (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
A.5.	Stabilize at Approach IDLE for 30 seconds.		
6.	Check Approach IDLE operation. Record data reading.	a1. F-15 - N_1C_2 between 4675 to 4875 rpm.	a1. Troubleshoot speed anomaly per WP 514 00.
		a2. Troubleshoot speed anomaly per WP 514 00.	a2. F-16 - N_1C_2 within limits (4025 to 4225 rpm; no change from GROUND IDLE).
		b. FTIT within limits per WP 205 00.	b. Troubleshoot FTIT system anomaly per WP 536 00.
		c. Vibration within limits per WP 205 00.	c. Troubleshoot vibration anomaly per WP 544 00.
		d. ENP above 80%	d. Troubleshoot ENP anomaly per WP 513 00.
		e. MOP within limits per WP 205 00.	e. Troubleshoot anomaly per WP 529 00 or WP 530 00.
7.	Turn IDLE NOZZLE POSITION OFF.	ENP closes to less than 20%.	Troubleshoot anomaly per WP 513 00.
8.	Stabilize at Flight IDLE for 30 seconds.	FTIT, vibration, and MOP within limits of WP 205 00.	Troubleshoot anomaly per WP 500 00.
9.	Turn IDLE NOZZLE POSITION to RESET.	ENP opens to above 80%.	Troubleshoot ENP out of limits per WP 513 00.
10.	Turn GROUND IDLE switch ON.	Light illuminates.	

Table 1. Acceptance Test (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
A.11.	Turn ANTI-ICE ON.	ANTI-ICE ON light illuminates. TAI temperature (EMSE) increases.	Troubleshoot anti-ice system malfunction per WP 517 00.
12.	Turn ANTI-ICE OFF.	ANTI-ICE ON light extinguishes. TAI temperature (EMSE) decreases.	Troubleshoot anti-ice system malfunction per WP 517 00.
13.	Perform engine shutdown per WP 225 00.		
14.	Perform engine start in SECONDARY mode per WP 210 00.		
15.	Turn PRIMARY mode ON. Stabilize 5 minutes.	a. SECONDARY mode light extinguishes. PRIMARY mode light illuminates. b. ENP opens to greater than 80%.	a. Troubleshoot mode-select malfunction per WP 522 00. b. Troubleshoot ENP anomaly per WP 513 00.
16.	Record seven individual FTIT probe temperatures (from EMSE) at IDLE.	Temperature indication for each FTIT probe.	Troubleshoot anomaly per WP 536 00.
17.	Calculate mathematical average of all seven IDLE FTIT temperatures recorded in step A.16. to determine average IDLE FTIT. Compare individual FTIT probe temperatures with average IDLE FTIT.	a. Difference between maximum sensor value and average FTIT value within limits per WP 205 00. b. Difference between minimum sensor value and average FTIT value within limits per WP 205 00.	a. Troubleshoot FTIT spread anomaly per WP 542 00. b. Troubleshoot FTIT spread anomaly per WP 542 00.
18.	Ensure engine has been at IDLE for a minimum of 9 minutes before going to next step.		

Table 1. Acceptance Test (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
A.19.	Monitor N_1, N_2, FTIT and VDCH during accel to Intermediate (MIL).		
20.	Move throttle to Intermediate (MIL). Stabilize 6 minutes or until EMSE displays performance data recorded.	a. N_1, N_2, and FTIT limits not exceeded per WP 205 00.	a. Troubleshoot anomaly per WP 540 00, WP 541 00, or WP 536 00.
		b. Vibrations within limits per WP 205 00.	b. Troubleshoot anomaly per WP 544 00.
		c. MOP within limits per WP 205 00.	c. Troubleshoot anomaly per WP 529 00 or WP 530 00.
		d. PLAAB between 83 to 88 degrees. EMSE displays performance data recorded indication within 6 minutes.	d. Troubleshoot PLA rigging per WP 102 00.

Table 1. Acceptance Test (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
21.	Check engine performance. Record data reading.	a. MOP rise from IDLE to Intermediate (MIL) equal to or more than 15 psi.	a. Troubleshoot MOP anomaly per WP 531 00.
		b. Ps2 (bellmouth) minus Ps2 (EMSE) between 0.0 to 0.5 in. Hg.	b. Troubleshoot Ps2 out of limits per WP 548 00.
		c. ENP -5 to +10%.	c. Troubleshoot ENP out of limits per WP 513 00.
		d. Tt2A (EMSE/DEEC) minus Tt2B (EMSE/DEEC) between -3.0 to +3.0°C (-5.4 to +5.4°F).	d. Troubleshoot Tt2 out of limits per WP 547 00.
		e. FTITLG (User Defined Parameter (UDP)) minus FTIT between -10 to +10°C (-18 to +18°F).	e. Troubleshoot FTIT out of limits per WP 536 00.
		f. Breather pressure (Pmb) within limits per WP 205 00.	f. Troubleshoot breather pressure system anomaly WP 529 00.

Table 1. Acceptance Test (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
A.22.	Record seven individual FTIT probe temperatures (from EMSE) at Intermediate (MIL).	Temperature indication for each FTIT probe.	Troubleshoot anomaly per WP 536 00.
23.	Calculate mathematical average of all seven Intermediate (MIL) FTIT temperatures recorded in step A.22. to determine average Intermediate (MIL) FTIT. Compare individual FTIT probe temperatures with average Intermediate (MIL) FTIT.	a. Difference between maximum individual sensor value and average FTIT within limits per WP 205 00.	a. Troubleshoot FTIT spread anomaly per WP 542 00.
		b. Difference between minimum individual sensor value and average FTIT value within limits per WP 205 00.	b. Troubleshoot FTIT spread anomaly per WP 542 00.
24.	Turn RIGHT AUGMENTOR ignition switch OFF.	RIGHT AUGMENTOR igniter light illuminates amber.	Troubleshoot test stand.
25.	Move throttle to MAX. Stabilize 1 minute.	a. N_1, N_2, and FTIT within limits per WP 205 00.	a. Troubleshoot anomaly per WP 540 00, WP 541 00, or WP 536 00.
		b. Vibrations within limits per WP 205 00.	b. Troubleshoot anomaly per SWP 544 01.
		c. MOP within limits per WP 205 00.	c. Troubleshoot anomaly per WP 529 00 or WP 530 00.
		d. Augmentor lights normally.	d. Snap throttle to IDLE. Troubleshoot augmentor anomaly per WP 512 00.
26.	Move throttle to IDLE. Stabilize 1 minute.		
27.	Turn SECONDARY mode ON.	a. SECONDARY mode light illuminates. PRIMARY mode light extinguishes.	a. Troubleshoot mode-select malfunction per WP 522 00.
		b. ENP closes to less than 5%.	b. Troubleshoot ENP-SEC mode anomaly per WP 524 00.

Table 1. Acceptance Test (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
B.	**Steady State SEC Mode Checks (RCVV/CIVV/$N_2C_{2.5}$/ ENP)**		
1.	Ensure engine has stabilized 5 minutes at IDLE.		
2.	Check IDLE operation. Record data reading.	a. RCVV position within limits per table 2.	a. Troubleshoot RCVV position out of limits-SEC mode anomaly per WP 525 00.
		b. CIVV moves to within cambered limits (–23 to –19 degrees).	b. Troubleshoot CIVV malfunction-SEC mode per WP 526 00.
		c. $N_2C_{2.5}$ rpm within limits per table 3.	c. Troubleshoot $N_2C_{2.5}$ out of limits-SEC mode per WP 539 00.
		d. Vibrations within limits per WP 205 00.	d. Troubleshoot vibration out of limits per WP 544 00.
3.	Advance throttle to position RCVVs (EMSE) to –17 to -13 degrees. Verify RCVVs move by 30 degrees PLAAB. Stabilize 1 minute.	No limits exceeded	Troubleshoot anomaly per WP 500 00.
4.	Check part power operation. Record data reading.	a. RCVV position within limits per table 2.	a. Troubleshoot RCVV position out of limits-SEC mode anomaly per WP 525 00.
		b. CIVVs remain cambered (–23 to –19 degrees).	b. Troubleshoot CIVV malfunction-SEC mode per WP 526 00.
		c. ENP within limits (less than 5%).	c. Troubleshoot ENP out of limits-SEC mode anomaly per WP 524 00.
		d. Vibrations within limits per WP 205 00.	d. Troubleshoot vibration out of limits per WP 544 00.
5.	Move throttle to Intermediate (MIL). Stabilize 2 minutes.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.

Table 1. Acceptance Test (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
B.6.	Check Intermediate (MIL) operation. Record data reading.	a. RCVV within limits per table 2.	a. Troubleshoot RCVV position out of limits-SEC mode anomaly per WP 525 00.
		b. CIVVs remain cambered (−23 to −19 degrees).	b. Troubleshoot CIVV-SEC mode anomaly per WP 526 00.
		c. $N_2C_{2.5}$ (EMSE) within limits per table 4.	c. Troubleshoot $N_2C_{2.5}$ out of limits-SEC mode anomaly per WP 539 00.
		d. ENP within limits (less than 5%).	d. Troubleshoot ENP out of limits-SEC mode anomaly per WP 524 00.
		e. Vibrations within limits.	e. Troubleshoot vibration out of limits per WP 544 00.
7.	Move throttle to IDLE.		
8.	Turn PRIMARY mode ON. Stabilize 15 minutes.	a. SECONDARY mode light extinguishes. PRIMARY mode light illuminates.	a. Troubleshoot mode-select malfunction per WP 522 00.
		b. ENP above 80%.	b. Troubleshoot ENP anomaly per WP 513 00.
C.	**Acceleration/Deceleration Checks In Primary Mode.**		
1.	Turn RIGHT AUGMENTOR ignition switch ON.	RIGHT AUGMENTOR igniter light illuminates green.	Troubleshoot test stand.
2.	Turn LEFT AUGMENTOR ignition switch OFF.	LEFT AUGMENTOR igniter light illuminates amber.	Troubleshoot test stand.

CAUTION

Failure to ensure engine stabilization as specified can result in engine falsely passing accel/decel check and encountering engine stalls in flight.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
3.	Ensure engine has been at IDLE for 15 minutes minimum.		

Table 1. Acceptance Test (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
C.4.	Perform 5 second accel from Ground IDLE to Intermediate (MIL). Stabilize 25 seconds.	No limits exceeded.	Troubleshoot augmentor anomaly per WP 500 00.
5.	Snap throttle to MAX. Stabilize 10 seconds.	a. ENP opens. b. All segments light.	Troubleshoot augmentor anomaly per WP 512 00.
6.	Snap throttle to Intermediate (MIL). Stabilize 2 minutes.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
7.	Turn LEFT AUGMENTOR ignition switch ON.	LEFT AUGMENTOR igniter light illuminates green.	Troubleshoot test stand.
8.	Snap throttle to IDLE. Stabilize 5 seconds.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
9.	Snap throttle to Intermediate (MIL). Stabilize 10 seconds.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
10.	Snap throttle to MAX. Stabilize 30 seconds.	a. ENP opens. b. All segments light.	Troubleshoot augmentor anomaly per WP 512 00.
11.	Snap throttle to Intermediate (MIL). Stabilize 5 seconds.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
12.	Snap throttle to MAX. Stabilize 5 seconds.	a. ENP opens. b. All segments light.	Troubleshoot augmentor anomaly per WP 512 00.
13.	Snap throttle to IDLE. Stabilize 15 seconds.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
14.	Snap throttle to MAX. Stabilize 5 seconds.	a. ENP opens. b. All segments light.	Troubleshoot augmentor anomaly per WP 512 00.
15.	Snap throttle to Intermediate (MIL).	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
16.	Turn IDLE EXHAUST NOZZLE OFF.	ENP closes to less than 20%.	Troubleshoot ENP out of limits per WP 513 00.
17.	Stabilize at Intermediate (MIL) for 60 seconds.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.

Table 1. Acceptance Test (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
C.18.	Snap throttle to IDLE. Stabilize 2 minutes.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
19.	Snap throttle to Intermediate (MIL). Stabilize 10 seconds.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
20.	Snap throttle to MAX. Stabilize 30 seconds.	a. ENP opens. b. All segments light.	Troubleshoot augmentor anomaly per WP 512 00.
21.	Snap throttle to Intermediate (MIL). Stabilize 5 seconds.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
22.	Snap throttle to MAX. Stabilize 5 seconds.	a. ENP opens. b. All segments light.	Troubleshoot augmentor anomaly per WP 512 00.
23.	Snap throttle to IDLE. Stabilize 15 seconds.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
24.	Snap throttle to MAX. Stabilize 5 seconds.	a. ENP opens. b. All segments light.	Troubleshoot augmentor anomaly per WP 512 00.
25.	Snap throttle to Intermediate (MIL). Stabilize 60 seconds.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
26.	Snap throttle to IDLE.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
27.	Turn IDLE EXHAUST NOZZLE to RESET.	ENP opens to above 80%.	Troubleshoot ENP out of limits per WP 513 00.
28.	Stabilize at IDLE for 60 seconds.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
29.	Perform 10 seconds accel to Intermediate (MIL). Stabilize 60 seconds.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
30.	Turn SECONDARY mode ON.	a. SECONDARY mode light illuminates and PRIMARY mode light extinguishes. b. ENP closes to less than 5%.	a. Troubleshoot mode-select malfunction per WP 522 00. b. Troubleshoot ENP out of limits-SEC mode per WP 524 00.

Table 1. Acceptance Test (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
C.31.	Snap throttle to IDLE. Stabilize 60 seconds.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
32.	Turn PRIMARY mode ON.	a. PRIMARY mode light illuminates and SECONDARY mode light extinguishes.	a. Troubleshoot mode-select malfunction per WP 522 00.
		b. ENP opens to above 80%.	b. Troubleshoot ENP out of limits-PRIMARY mode per WP 513 00.
D.	**Acceleration/Deceleration Checks In Secondary Mode.**		
1.	Turn SECONDARY mode ON.	a. SECONDARY mode light illuminates. PRIMARY mode light extinguishes.	a. Troubleshoot mode-select malfunction per WP 522 00.
		b. ENP closes to below 5%.	b. Troubleshoot ENP-SEC mode anomaly per WP 524 00.
2.	Snap throttle to Intermediate (MIL). Stabilize 10 seconds.	a. No limits exceeded.	a. Troubleshoot anomaly per WP 500 00.
		b. ENP less than 5%.	b. Troubleshoot ENP anomaly per WP 524 00.
		c. CIVVs remain cambered (−23 to −19 degrees).	c. Troubleshoot CIVV-SEC mode anomaly per WP 526 00.
3.	Turn PRIMARY mode ON.	a. N_1, N_2, and FTIT limits not exceeded.	a. Troubleshoot anomaly per WP 540 00, WP 541 00, or WP 536 00.
		b. PRIMARY mode light illuminates. SECONDARY mode light extinguishes.	b. Troubleshoot mode-select malfunction per WP 522 00.
		c. CIVVs move in axial direction.	c. Troubleshoot CIVV-PRIMARY mode anomaly per WP 538 00.

Table 1. Acceptance Test (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
D.4.	Snap throttle into augmentation (segments 2 to 3). Stabilize 5 seconds.	ENP opens smoothly.	Troubleshoot augmentor anomaly per WP 512 00.
5.	Turn SECONDARY mode ON.	a. Augmentor operation stops.	a. Troubleshoot augmentor anomaly per WP 512 00.
		b. SECONDARY mode light illuminates. PRIMARY mode light extinguishes.	b. Troubleshoot mode-select malfunction per WP 522 00.
		c. ENP closes to less than 5%.	c. Troubleshoot ENP-SEC mode anomaly per WP 524 00.
		d. CIVVs move to within cambered limits (−23 to −19 degrees).	d. Troubleshoot CIVV malfunction per WP 526 00.
6.	Move throttle to Intermediate (MIL). Stabilize 5 seconds.		
7.	Snap throttle to IDLE.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
8.	When N_2 reaches 10,000 rpm, or after 6 seconds (if N_2 does not reach 10,000 rpm), snap throttle to Intermediate (MIL). Stabilize 30 seconds.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
9.	Turn PRIMARY mode ON.	PRIMARY mode light illuminates. SECONDARY mode light extinguishes.	Troubleshoot mode-select malfunction per WP 522 00.
10.	Snap throttle to IDLE. Stabilize 30 seconds.	No limits exceeded.	Troubleshoot anomaly per WP 500 00.
11.	Perform engine shutdown per WP 225 00.		

Table 1. Acceptance Test (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
E.	**Main Ignition Circuit Checks**		
1.	Turn RH IGN INHIBIT ON.	RH IGN INHIBIT light illuminates.	Troubleshoot test cell.
2.	Start engine. Monitor engine ignition during start. When FTIT increases more than 20°C (36°F), shut down engine.	Engine ignites within 30 seconds (indicated by rapid rise in FTIT).	Troubleshoot start anomaly per WP 509 00.
3.	Turn RH IGN INHIBIT OFF.	RH IGN INHIBIT light extinguishes.	Troubleshoot test cell.
4.	Turn LH IGN INHIBIT ON.	LH IGN INHIBIT light illuminates.	Troubleshoot test cell.
5.	Start engine. Monitor engine ignition during start. When FTIT increases more than 20°C (36°F), shut down engine.	Engine ignites within 30 seconds (FTIT rises).	Troubleshoot start anomaly per WP 509 00.
6.	Turn LH IGN INHIBIT OFF.	LH IGN INHIBIT light extinguishes.	Troubleshoot test cell.
7.	Perform engine posttest procedures per WP 300 00.		

Table 2. RCVV Check Band - Secondary Mode

PLA (deg.)	RCVV CHECK BAND LIMITS-DEGREES	
	Min	Max
16	-35.00	-27.00
17	-35.00	-27.00
18	-35.00	-27.00
19	-35.00	-27.00
20	-35.00	-27.00
21	-34.60	-26.60
22	-34.20	-26.20
23	-33.80	-25.80
24	-33.40	-25.40
25	-33.00	-25.00
26	-32.60	-24.60
27	-32.20	-24.20
28	-31.80	-23.80
29	-31.40	-23.40
30	-31.00	-23.00
31	-30.60	-22.60
32	-30.20	-22.20
33	-29.80	-21.80
34	-29.40	-21.40
35	-29.00	-21.00
36	-28.60	-20.60
37	-28.20	-20.20
38	-27.80	-19.80
39	-27.40	-19.40
40	-27.00	-19.00
41	-26.60	-18.60
42	-26.20	-18.20
43	-25.80	-17.80
44	-25.40	-17.40
45	-25.00	-17.00
46	-24.60	-16.60
47	-24.20	-16.20
48	-23.80	-15.80
49	-23.40	-15.40
50	-23.00	-15.00
51	-22.60	-14.60
52	-22.20	-14.20
53	-21.80	-13.80
54	-21.40	-13.40
55	-21.00	-13.00
56	-20.60	-12.60
57	-20.20	-12.20
58	-19.80	-11.80
59	-19.40	-11.40
60	-19.00	-11.00
61	-18.60	-10.60
62	-18.20	-10.20
63	-17.80	-9.80
64	-17.40	-9.40
65	-17.00	-9.00
66	-16.80	-8.60
67	-16.20	-8.20
68	-15.80	-7.80
69	-15.40	-7.40
70	-15.00	-7.00
71	-14.63	-6.62
72	-14.26	-6.24
73	-13.89	-5.86
74	-13.52	-5.48
75	-13.15	-5.10
76	-12.78	-4.72
77	-12.41	-4.34
78	-12.04	-3.96
79	-11.67	-3.58
80	-11.30	-3.20
81	-10.90	-2.80
82	-10.50	-2.40
83 THRU 130	-10.10	-2.00

Table 3. IDLE $N_2C_{2.5}$ vs T_{t2} - Secondary Mode

T_{t2} °C	T_{t2} °F	$N_2C_{2.5}$ rpm Min	$N_2C_{2.5}$ rpm Max
-30	-22.0	9657	11151
-29	-20.2	9650	11141
-28	-18.4	9644	11132
-27	-16.6	9637	11123
-26	-14.8	9630	11113
-25	-13.0	9623	11104
-24	-11.2	9617	11094
-23	-9.4	9610	11085
-22	-7.6	9603	11075
-21	-5.8	9596	11066
-20	-4.0	9590	11056
-19	-2.2	9583	11047
-18	-0.4	9576	11038
-17	1.4	9569	11028
-16	3.2	9563	11019
-15	5.0	9556	11009
-14	6.8	9549	11000
-13	8.6	9542	10990
-12	10.4	9536	10981
-11	12.2	9529	10971
-10	14.0	9522	10962
-9	15.8	9515	10952
-8	17.6	9509	10943
-7	19.4	9502	10934
-6	21.2	9495	10924
-5	23.0	9488	10915
-4	24.8	9482	10905
-3	26.6	9475	10896
-2	28.4	9468	10886
-1	20.0	9461	10877
0	32.0	9455	10867
1	33.8	9448	10858
2	35.6	9441	10849
3	37.4	9434	10839
4	39.2	9428	10830
5	41.0	9421	10820
6	42.8	9414	10811
7	44.6	9407	10801
8	46.4	9401	10792
9	48.2	9394	10782
10	50.0	9387	10773
11	51.8	9380	10763
12	53.6	9374	10754
13	55.4	9367	10745
14	57.2	9360	10735
15	59.0	9353	10726
16	60.8	9348	10718
17	62.6	9343	10713
18	64.4	9339	10707
19	66.2	9334	10702
20	68.0	9330	10698
21	69.8	9325	10691
22	71.6	9321	10686
23	73.4	9316	10680
24	75.2	9312	10675
25	77.0	9307	10669
26	78.8	9303	10664
27	80.6	9301	10662
28	82.4	9306	10668
29	84.2	9310	10673
30	86.0	9315	10678
31	87.8	9315	10684
32	89.6	9324	10689
33	91.4	9328	10695
34	93.2	9333	10700
35	95.0	9337	10705
36	96.8	9342	10711
37	98.6	9346	10716
38	100.4	9351	10723
39	102.2	9359	10734
40	104.0	9368	10744
41	105.8	9376	10755
42	107.6	9384	10766
43	109.4	9392	10777
44	111.2	9400	10788
45	113.0	9408	10798
46	114.8	9416	10809
47	116.6	9424	10820
48	118.4	9432	10831
49	120.2	9440	10842
50	122.0	9449	10852

Table 4. Intermediate (MIL) $N_2C_{2.5}$ vs T_{t2} - Secondary Mode

T_{t2} °C	T_{t2} °F	$N_2C_{2.5}$ rpm Min	$N_2C_{2.5}$ rpm Max
-30	-22.0	10102	10903
-29	-20.2	10100	10901
-28	-18.4	10097	10898
-27	-16.6	10095	10896
-26	-14.8	10093	10894
-25	-13.0	10090	10891
-24	-11.2	10088	10889
-23	-9.4	10086	10887
-22	-7.6	10083	10884
-21	-5.8	10081	10882
-20	-4.0	10079	10880
-19	-2.2	10076	10877
-18	-0.4	10074	10875
-17	1.4	10072	10873
-16	3.2	10069	10870
-15	5.0	10067	10868
-14	6.8	10065	10866
-13	8.6	10062	10863
-12	10.4	10060	10861
-11	12.2	10058	10859
-10	14.0	10055	10856
-9	15.8	10053	10854
-8	17.6	10051	10852
-7	19.4	10048	10849
-6	21.2	10046	10847
-5	23.0	10044	10845
-4	24.8	10041	10842
-3	26.6	10039	10840
-2	28.4	10037	10838
-1	20.0	10034	10835
0	32.0	10032	10833
1	33.8	10030	10831
2	35.6	10027	10828
3	37.4	10025	10826
4	39.2	10023	10823
5	41.0	10020	10821
6	42.8	10018	10819
7	44.6	10016	10816
8	46.4	10013	10814
9	48.2	10011	10812
10	50.0	10009	10809
11	51.8	10006	10807
12	53.6	10004	10805
13	55.4	10002	10802
14	57.2	9999	10800
15	59.0	9997	10798
16	60.8	9994	10795
17	62.6	9992	10793
18	64.4	9990	10791
19	66.2	9987	10788
20	68.0	9985	10786
21	69.8	9983	10784
22	71.6	9980	10781
23	73.4	9978	10779
24	75.2	9976	10777
25	77.0	9973	10774
26	78.8	9971	10772
27	80.6	9965	10766
28	82.4	9955	10754
29	84.2	9940	10741
30	86.0	9928	10728
31	87.8	9915	10716
32	89.6	9902	10703
33	91.4	9890	10691
34	93.2	9877	10678
35	95.0	9865	10665
36	96.8	9852	10653
37	98.6	9839	10640
38	100.4	9830	10630
39	102.2	9830	10630
40	104.0	9830	10630
41	105.8	9830	10630
42	107.6	9830	10630
43	109.4	9830	10630
44	111.2	9830	10630
45	113.0	9830	10630
46	114.8	9830	10630
47	116.6	9830	10630
48	118.4	9830	10630
49	120.2	9830	10630
50	122.0	9830	10630

WORK PACKAGE

TECHNICAL PROCEDURES

ACCELERATION/DECELERATION CHECKS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
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REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00
Engine Start Procedures	WP 210 00
Engine Acceptance Test	WP 212 00
Engine Shutdown	WP 225 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains acceleration/deceleration checks.

2. PRELIMINARY INSTRUCTIONS.

a. Perform pretest requirements per WP 100 00.

b. Review engine operating limits per WP 205 00.

c. Determine engine test requirements per WP 206 00.

d. Perform engine prestart per WP 207 00.

e. Review ground safety procedures per WP 208 00.

f. Review emergency procedures per WP 209 00.

g. Review engine performance parameters per WP 212 00.

3. ACCELERATION/DECELERATION CHECKS.

(See Table 1.)

NOTE

On enclosed stand, unstable check points may occur due to ingestion of exhaust gas under certain weather conditions. If ingestion occurs during unstable check points, terminate test until weather conditions allow acceptable and repeatable check points.

a. Perform engine acceleration/decelerations checks per table 1.

Table 1. Acceleration/Deceleration Checks

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
	Acceleration/Deceleration Check - PRIMARY Mode		
1.	Perform engine start in PRIMARY mode per WP 210 00. Turn anti-ice ON.		
2.	Ensure engine stabilizes at IDLE for 5 minutes.		
3.	Check Ground IDLE operation. Record data reading.	a. N_1C_2 within 4,025 to 4,225 rpm.	a.1. If N_1C_2 is above limit and Pb is 43 to 51 psia: engine operation is normal. a.2. If N_1C_2 is above limit and Pb is not between 43 to 51 psia: troubleshoot IDLE speed out-of-limits. a.3. If N_1C_2 is below limit: troubleshoot IDLE speed out-of-limits.
		b. FTIT within limits per WP 205 00.	b. Troubleshoot FTIT anomaly.

Table 1. Acceleration/Deceleration Checks (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
3.	(continued)	c. Vibration within limits per WP 205 00. d. ENP greater than 80%. e. MOP within limits per WP 205 00.	c. Troubleshoot vibration anomaly. d. Troubleshoot ENP anomaly. e. Troubleshoot MOP anomaly.
4.	Turn Idle Exhaust Nozzle (IAR) OFF.	ENP closes to less than 20% and N_1 rpm increases.	Troubleshoot ENP out-of-limits.
5.	Stabilize at Flight IDLE for 10 minutes.	a. FTIT within limits per WP 205 00. b. Vibration within limits per WP 205 00. c. MOP within limits per WP 205 00.	a. Troubleshoot FTIT anomaly. b. Troubleshoot vibration anomaly. c. Troubleshoot MOP anomaly.
6.	Verify engine has been operating at IDLE for 15 minutes minimum before continuing to step 7.		
7.	Perform snap acceleration to Intermediate (MIL). Stabilize 30 seconds.	a. No N_1, N_2, or FTIT limits exceeded per WP 205 00. b. Vibration within limits per WP 205 00. c. MOP within limits per WP 205 00. d. ENP less than 20%.	Troubleshoot out-of-limits parameter(s).
8.	Snap throttle to MAX. Stabilize 10 seconds.		
9.	Snap throttle to Intermediate (MIL). Stabilize 2 minutes.		
10.	Compare P_{s2} between EMSE and other test cell instruments.	P_{s2} (Test Cell) - P_{s2} (EMSE) is 0.0 to 0.4 in. Hg.	Troubleshoot anomaly.

Table 1. Acceleration/Deceleration Checks (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
CAUTION Sudden nozzle closure indicates augmentor no-light, blowout, or sequencing stall has occurred.			
11.	Snap throttle to MAX. Stablize 60 seconds.	a. ENP opens smoothly. b. All augmentor segments light.	Troubleshoot augmentor anomaly.
12.	Snap throttle to IDLE. Stabilize 5 seconds.		
13.	Snap throttle to MAX. Stabilize 30 seconds. Turn Idle Exhaust Nozzle ON.		
14.	Snap throttle to IDLE. Stabilize 5 seconds, snap throttle to MAX. Stabilize 5 seconds.	a. ENP opens smoothly within limits. b. All augmentor segments light.	Troubleshoot augmentor anomaly.
15.	Snap throttle to Intermediate (MIL) and stabilize 10 seconds.		

Table 1. Acceleration/Deceleration Checks (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
16.	Turn SECONDARY mode ON. Stabilize 1 minute.	a. SECONDARY mode light illuminates. b. ENP closes to less than 5%. c. CIVV moves within cambered limits (–23 to –19 degrees).	a. Troubleshoot mode-select anomaly. b. Troubleshoot ENP-SEC mode anomaly. c. Troubleshoot CIVV anomaly.
17.	Check $N_2C_{2.5}$ rpm.	$N_2C_{2.5}$ rpm within limits per WP 212 00, table 4.	Troubleshoot N_2 rpm anomaly.
18.	Snap throttle to IDLE. Stabilize 1 minute.		
19.	Turn PRIMARY mode ON.	a. PRIMARY mode light illuminates. b. ENP greater than 80%.	a. Troubleshoot mode-select anomaly. b. Troubleshoot ENP anomaly.

CAUTION

Do not shutdown using main fuel switch/handle except for emergency. Use of main fuel switch/handle can lead to cavitation of main fuel pump and possible damage.

NOTE

Acceleration to Intermediate (MIL) shall not be performed for DEEC logic 2.7.0 before step 20 is accomplished.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
20.	Perform engine shutdown engine per WP 225 00.		

WORK PACKAGE

TECHNICAL PROCEDURES

PRIMARY MODE FUNCTIONAL CHECK

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
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REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Ground Safety Precautions	WP 208 00
Engine Start Procedures	WP 210 00
Engine Acceptance Test	WP 212 00
Engine Shutdown	WP 225 00
Engine Troubleshooting - General	WP 501 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains the primary mode functional check.

2. PRELIMINARY INSTRUCTIONS.

a. Perform pretest requirements in WP 100 00.

b. Review engine operating limits in WP 205 00.

c. Determine engine test requirements per WP 206 00.

d. Perform engine prestart per WP 207 00.

e. Review ground safety precautions in WP 208 00.

f. Review emergency procedures in WP 209 00.

3. PRIMARY MODE FUNCTIONAL CHECK.
(See Table 1.)

a. Use table 1 of WP 212 00 to select engine parameters to be displayed on Engine Monitoring Support Equipment (EMSE).

b. Perform engine Primary Mode Functional Check per table 1.

CAUTION

On enclosed stands, unstable check points may occur due to reingestion of exhaust gas under certain weather conditions. If reingestion occurs during unstable check points, terminate test until weather conditions allow acceptable and repeatable check points.

Table 1. Primary Mode Functional Check

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
1.	Start engine in PRIMARY mode.		
2.	Ensure engine stabilizes 5 minutes at IDLE.		
3.	Check Ground IDLE operation. Record data reading.	a. N_1 C_2 within 4025 and 4225 rpm.	a.1. If N_1 C_2 is above limit and Pb is 43 to 51 psia, engine operation is normal. a.2. If N_1C_2 is above limit and Pb is not between 43 to 51 psia, troubleshoot IDLE speed out of limits. a.3. If N_1C_2 is below limit, troubleshoot IDLE speed out of limits.
		b. FTIT within limits.	b. Troubleshoot FTIT anomaly.
		c. ENP greater than 80%.	c. Troubleshoot ENP anomaly.
4.	Move throttle to obtain 11,200 N_2 rpm. Stabilize 1 minute.	No limits exceeded.	Troubleshoot parameter out of limits.
5.	Check part power operation. Record data reading.	No limits exceeded.	Troubleshoot parameter out of limits.
6.	Snap throttle to IDLE.		
7.	Shut down engine. Refer to WP 225 00.		

WORK PACKAGE

TECHNICAL PROCEDURES

SECONDARY MODE FUNCTIONAL CHECK

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
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2	21				

REFERENCE MATERIAL REQUIRED

Title	Number
Depot Engine Test	T.O. 2J-F100-11-2
Ground Safety Precautions	WP 208 00
Engine Start Procedures	WP 210 00
Engine Acceptance Test	WP 212 00
Engine Shutdown	WP 225 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. **INTRODUCTION.**

a. This work package contains the Secondary Mode functional check.

2. **PRELIMINARY INSTRUCTIONS.**

a. Perform pretest requirements in WP 200 00.

b. Review engine operating limits in WP 205 00.

c. Determine engine test requirements per WP 206 00.

d. Perform engine prestart per WP 207 00.

e. Review ground safety precautions in WP 208 00.

f. Review emergency procedures in WP 209 00.

3. **SECONDARY MODE FUNCTIONAL CHECK.** (See Table 1.)

a. Select engine parameters to be displayed on Engine Monitoring Support Equipment (EMSE).

CAUTION

- Engine operation with RCVVs in extreme axial position at low $N_2C_{2.5}$ speed could cause compressor blade fatigue and possible compressor damage.
- Engine operaton with RCVV position between −4.0 degrees to +10.0 degrees at $N_2C_{2.5}$ below 9650 rpm for more than 2 seconds will cause damage to core module, requiring core module be returned to depot.

NOTE

- Reingestion of exhaust gas, under certain weather conditions is possible and may cause false rejection of serviceable engine.
- Refer to WP 208 00 for reference wind direction/ velocity limitations for open field test stand engine test.
- If reingestion of exhaust gas occurs during test, resulting in unstable check points, test shall be terminated until weather conditions allow acceptable and repeatable check points.
- Engine troubleshooting shall be performed to determine cause and corrective action before core module replacement.

b. Perform engine Secondary Functional Check per table 1.

Table 1. Secondary Mode Functional Check

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
1.	Perform engine start in SECONDARY mode per WP 210 00.		
2.	Ensure engine has stabilizes 5 minutes at IDLE.		
3.	Check IDLE operation. Record data reading.	a. RCVV (EMSE) position within limits per WP 212 00, table 2.	a. Troubleshoot RCVV-SEC mode out of limits.
		b. CIVV (EMSE) within cambered limits (–23 to –19 degrees).	b. Troubleshoot CIVV-SEC mode anomaly.
		c. $N_2C_{2.5}$ rpm within limits per WP 212 00, table 3.	c. Troubleshoot $N_2C_{2.5}$-SEC mode anomaly.
		d. ENP less than 5%.	d. Troubleshoot ENP-SEC mode anomaly.

Table 1. Secondary Mode Functional Check (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
4.	Move throttle to obtain 11,200 N2 rpm. Stabilize 1 minute.	No limits exceeded.	Troubleshoot anomaly.
5.	Check part power operation. Record data reading.	a. RCVV (EMSE) within limits per WP 212 00, table 2.	a. Troubleshoot RCVV-SEC mode anomaly.
		b. CIVV (EMSE) remain cambered within limits (–23 to –19 degrees).	b. Troubleshoot CIVV-SEC mode anomaly.
		c. ENP less than 5%.	c. Troubleshoot ENP-SEC mode anomaly.
6.	Turn PRIMARY mode on.	a. Engine transfers to Primary Mode.	a. Troubleshoot mode-select malfunction.
		b. PRIMARY mode light illuminates.	b. Troubleshoot mode-select anomaly.
		c. SECONDARY mode light extinguishes.	c. Troubleshoot mode-select anomaly.
7.	Snap throttle to IDLE.		

Table 1. Secondary Mode Functional Check (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
8.	Turn SECONDARY mode on.	a. Engine transfers to SEC mode.	a. Troubleshoot mode-select malfunction.
		b. SECONDARY mode light illuminates.	b. Troubleshoot mode-select anomaly.
		c. ENP closes to less than 5%.	c. Troubleshoot ENP-SEC mode anomaly.
9.	Turn PRIMARY mode on.	a. Engine transfers to Primary Mode.	a. Troubleshoot mode-select malfunction.
		b. SECONDARY mode light extinguishes.	b. Troubleshoot mode-select anomaly.
		c. PRIMARY mode light illuminates.	c. Troubleshoot mode-select anomaly.
		d. ENP opens to above 80%.	d. Troubleshoot ENP anomaly.
10.	Stabilize 5 minutes at IDLE.		
11.	Perform engine shutdown per WP 225 00.		

WORK PACKAGE

TECHNICAL PROCEDURES

IDLE FUNCTIONAL CHECK

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Start Procedures	WP 210 00
Engine Shutdown	WP 225 00
Engine Troubleshooting - General	WP 501 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains the IDLE functional check.

2. PRELIMINARY INSTRUCTIONS.

a. Perform pretest requirements in WP 100 00.

b. Review engine operating limits in WP 205 00.

c. Determine engine test requirements per WP 206 00.

d. Perform engine prestart in WP 207 00.

e. Review ground safety precautions in WP 208 00.

f. Review emergency procedures in WP 209 00.

3. IDLE FUNCTIONAL CHECK.

(See Table 1.)

a. Perform engine Idle functional check per table 1.

Table 1. IDLE Functional Check

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
NOTE If engine is being started for first time after PLA resolver replacement or reinstallation, start engine in SECONDARY mode. Otherwise, start engine in PRIMARY mode.			
1.	Start engine.		
2.	Turn SECONDARY mode switch on.	a. SECONDARY mode light illuminates.	a. Troubleshoot mode-select anomaly.
		b. ENP closes within less than 5%.	b. Troubleshoot ENP-SEC mode anomaly.
		c. PLA between 15 to 20 degrees.	c.1. If PLA resolver was replaced before engine run, remove PLA resolver module and check installation. c.2. If PLA resolver installation is not suspected, troubleshoot anomaly.
3.	Turn PRIMARY mode switch on.	a. Engine transfers to Primary Mode.	a. Troubleshoot mode-select anomaly.
		b. PRIMARY mode light illuminates.	b. Troubleshoot mode-select anomaly.
		c. SECONDARY mode light extinguishes.	c. Troubleshoot mode-select anomaly.
		d. ENP opens above 80%.	d. Troubleshoot ENP anomaly.
		e. No faults present.	e. Troubleshoot faults.
4.	Shut down engine.		

WORK PACKAGE

TECHNICAL PROCEDURES

IGNITION SYSTEM FUNCTIONAL CHECK

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Start Procedures	WP 210 00
Engine Shutdown	WP 225 00
Engine Troubleshooting - General	WP 501 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains procedures for ignition system functional check procedures.

2. PRELIMINARY INSTRUCTIONS.

a. Perform pretest requirements in WP 100 00.

b. Review engine operating limits in WP 205 00.

c. Determine engine test requirements per WP 206 00.

d. Perform engine prestart per WP 207 00.

e. Review ground safety precautions in WP 208 00.

f. Review emergency procedures in WP 209 00.

3. IGNITION SYSTEM FUNCTIONAL CHECK.

(See Table 1.)

a. Perform engine ignition system functional check per table 1.

Table 1. Ignition System Functional Check

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
A.	Ignition System Checks - Main Circuit		
1.	Turn RH IGN INHIBIT on.	RH IGN INHIBIT light illuminates.	Troubleshoot test cell.
2.	Start engine.		Troubleshoot start anomaly.
3.	Stabilize 30 seconds at IDLE.		
4.	Shut down engine.		
5.	Turn RH IGN INHIBIT off.	RH IGN INHIBIT light extinguishes.	Troubleshoot test cell.
6.	Turn LH IGN INHIBIT on.	LH IGN INHIBIT light illuminates.	Troubleshoot test cell.
7.	Start engine.	Engine ignites within 30 seconds (FTIT rises).	Troubleshoot start anomaly.
8.	Stabilize at IDLE.		
9.	Turn LH IGN INHIBIT off.	LH IGN INHIBIT light extinguishes.	Troubleshoot test cell.
10.	If augmentor circuit testing is not required, shut down engine.		

Table 1. Ignition System Functional Check (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
B.	Ignition System Checks - Augmentor Circuit		
1.	If not previously accomplished, start engine.		
2.	Stabilize 5 minutes at IDLE.		
3.	Turn RH AUG IGNITION INHIBIT on.	RH AUG IGNITION INHIBIT light illuminates.	Troubleshoot test cell.

CAUTION

Observe exhaust nozzle position during augmentor operation. Sudden closure indicates an augmentor no-light, blowout, or sequencing stall has occurred. Repetitive ENP cycling (up to 3 re-cycles) indicates LOD operation. Check SYSTEM and AUGMENTOR/MN FAULT light if problem is suspected. Troubleshoot all faults.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
B.4.	Snap throttle to mid-range augmentation.	Augmentor lights normally.	Snap throttle to IDLE: a. Check for AUGMENTOR/MN or SYSTEM FAULT light. If fault light is illuminated, troubleshoot augmentor. If no fault light is illuminated, repeat test. b. If augmentor anomaly repeats, troubleshoot.
5.	Snap throttle to IDLE. Stabilize 4 minutes.		
6.	Turn RH AUG IGNITION INHIBIT off.	RH AUG IGNITION INHIBIT light extinguishes.	Troubleshoot test cell.
7.	Turn LH AUG IGNITION INHIBIT on.	LH AUG IGNITION INHIBIT light illuminates.	Troubleshoot test cell.

Table 1. Ignition System Functional Check (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
	CAUTION Observe exhaust nozzle position during augmentor operation. Sudden closure indicates an augmentor no-light, blowout, or sequencing stall has occurred. Repetitive ENP cycling (up to 3 re-cycles) indicates LOD operation. Check SYSTEM and AUGMENTOR/MN FAULT light if problem is suspected. Troubleshoot all faults.		
8.	Snap throttle to mid-range augmentation.	Augmentor lights normally.	Snap throttle to IDLE: a. Check for AUGMENTOR/MN or SYSTEM FAULT light. If fault light is illuminated, troubleshoot augmentor. If no fault light is illuminated, repeat test. b. If augmentor anomaly repeates, troubleshoot.
B. 9.	Snap throttle to IDLE. Stabilize 5 minutes.		
10.	Turn LH AUG IGNITION INHIBIT off.	LH AUG IGNITION INHIBIT light extinguishes.	Troubleshoot test cell.
11.	Shut down engine.		

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE VIBRATION ANALYSIS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 24

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	8	18A Added	8	19	8
2 - 17	7	18B Blank Added	8	20 - 22	7
18	8				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Emergency Procedures	WP 209 00
Engine Start Procedures	WP 210 00
Engine Acceptance Test	WP 212 00
Engine Shutdown	WP 225 00
Engine Posttest Servicing	WP 301 00
Engine	T.O. 2J-F100-53-5
Receiving Inspection	WP 006 00
Borescope Inspection	WP 020 00
Inlet/Fan Module	T.O. 2J-F100-53-6
Core Engine Module	T.O. 2J-F100-53-7
Rear Compressor Drive Turbine	T.O. 2J-F100-53-8
Fan Drive Turbine Module	T.O. 2J-F100-53-9

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION

a. This work package contains procedures for engine vibration analysis.

2. PRELIMINARY INSTRUCTIONS.

a. Perform pretest requirements in WP 100 00.

b. Review engine operating limits in WP 205 00.

c. Determine engine test requirements per WP 206 00.

d. Perform engine prestart per WP 207 00.

e. Review ground safety precautions in WP 208 00.

f. Review emergency procedures in WP 209 00.

3. ENGINE VIBRATION ANALYSIS.

(See Tables 1 through 6.)

a. Engine vibration analysis should be performed when troubleshooting for abnormal engine vibration or noise.

b. Perform appropriate analysis according to type of vibration equipment available as follows:

(1) Engine vibration analysis using PN VIC974FH. Vibration Analyzer is described in table 1.

(2) Engine vibration analysis using Spectral Dynamics Model 4112 Vibration Analyzer is described in table 3.

(3) Engine vibration analysis using TRIGTEK Model 623B. Vibration analyzer is described in table 5.

(4) Engine vibration analysis limits are given in table 2. Engine vibration analyzer PN VIC974FH Spectral Dynamics Model 4112 in table 4 and TRIGTEK Model 623B in table 6.

(5) Engine vibration analysis using Automated Vibration Inspection Diagnostics (AVID) system as described in Mechanical Technical Inc 83M30.

Table 1. Engine Vibration Analysis - PN VIC974FH

CAUTION

Perform engine rotation inspection before starting an engine with vibration anomaly.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
1.	Start engine in PRIMARY mode.		
2.	Stabilize engine 5 minutes at IDLE.	Engine operates within limits.	Troubleshoot as required.
3.	Turn ACCELEROMETER SELECTOR to VICV channel.	VICV within limits.	Terminate test. Check test stand vibration equipment.
4.	Accelerate slowly (approximately 60 seconds) between IDLE and Intermediate (MIL). Determine throttle setting at highest VICV.	a. VICV within limits. b. VICV exceeds limits.	a. Go to step 8. **NOTE** • Do not exceed 4.5 mils. • Do not allow engine to operate between table 2 limits and do not exceed limit(s) for more than 60 seconds. b. Adjust throttle to obtain highest VICV. Go to step 5.
5.	Turn FILTER MODE SELECTOR to TACHOMETER SELECTOR. Record N1 and N2 rpm.		

Table 1. Engine Vibration Analysis - PN VIC974FH (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
6.	Turn TACHOMETER SELECTOR to 1E1. Record N1 component of VICV vibration.	a. N1 component within limit.	a. Go to step 7.
		b. N1 component exceeds limit.	b.1. Check test cell vibration instruments for accuracy. b.2. If instruments are accurate, terminate test. b3. Troubleshoot engine per table 7.
7.	Turn TACHOMETER SELECTOR to TP2. Record N2 component of VICV vibration.	a. N2 component within limit.	a. Go to step 8.
		b. N2 component exceeds limit.	b.1. Check test cell vibration instruments for accuracy. b.2. If instruments are accurate, terminate test. b.3.Troubleshoot engine per table 8.
8.	Move throttle to IDLE.		
9.	Turn FILTER MODE SELECTOR to OVERALL.		
10.	Turn ACCELEROMETER SELECTOR to VDCH channel.	VDCH within limits.	Terminate test. Check test cell vibration equipment.
11.	Accelerate slowly (approximately 60 seconds) between IDLE and Intermediate (MIL). Determine throttle setting at highest VDCH.	a. VDCH within limits.	a. Go to step 15.

Table 1. Engine Vibration Analysis - PN VIC974FH (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
11. (continued)			**NOTE** • Do not exceed 2.5 mils. • Do not allow engine to operate between table 2 limits and do not exceed limit(s) for more than 60 seconds.
		b. VDCH exceeds limits.	b. Adjust throttle to obtain highest VDCH. Go to step 12.
12.	Turn FILTER MODE SELECTOR to TACHOMETER SELECTOR. Record N1 and N2 rpm.		
13.	Turn TACHOMETER SELECTOR to 1E1. Record N1 component of VDCH vibration.	a. N1 component within limit.	a. Go to step 14.
		b. N1 component exceeds limit.	b.1. Check test cell vibration instruments for accuracy. b.2. If instruments are accurate, terminate test. b.3. Troubleshoot engine per table 7.
14.	Turn TACHOMETER SELECTOR to TP2. Record N2 component of VDCH.	a. N2 component within limit.	a. Go to step 15.
		b. N2 component exceeds limit.	b.1. Check test cell vibration instruments for accuracy. b.2. If instruments are accurate, terminate test. b.3. Troubleshoot engine per table 8.

Table 1. Engine Vibration Analysis - PN VIC974FH (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
15.	Move throttle to IDLE.		
16.	Turn FILTER MODE SELECTOR to OVERALL.		
17.	Turn ACCELEROMETER SELECTOR to VAP6 channel.	VAP6 within limits	Terminate test. Check test stand vibration equipment.
18.	Accelerate slowly (approximately 60 seconds) between IDLE and Intermediate (MIL). Determine throttle setting at highest VAP6.	a. VAP6 is within limits. b. VAP6 exceeds limits.	a. Go to step 22. **NOTE** • Do not exceed 4.5 mils. • Do not allow engine to operate between table 2 limits and do not exceed limit(s) for more than 60 seconds. b. Adjust throttle to obtain highest VAPG. Go to step 19.
19.	Turn FILTER MODE SELECTOR to TACHOMETER SELECTOR. Record N1 and N2 rpm.		
20.	Turn TACHOMETER SELECTOR to 1E1. Record N1 component of VAP6 vibration.	a. N1 component within limit.	a. Go to step 21.

Table 1. Engine Vibration Analysis - PN VIC974FH (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
20. (continued)		b. N1 component exceeds limit.	b.1. Check test cell vibration instruments for accuracy. b.2. If instruments are accurate, terminate test. b.3. Troubleshoot engine per table 7.
21.	Turn TACHOMETER SELECTOR to TP2. Record N2 component of VAP6 vibration.	a. N2 component within limit.	a. Go to step 22.
		b. N2 component exceeds limit.	b.1. Check test cell vibration instruments for accuracy. b.2. If instruments are accurate, terminate test. b.3. Troubleshoot engine per table 8.
22.	Move throttle to IDLE.		
23.	Turn FILTER MODE SELECTOR to OVERALL.		
24.	Turn ACCELEROMETER SELECTOR to VGBV.	a. VGBV within limits.	a. Terminate test. Check test cell vibration equipment.
25.	Accelerate slowly (approximately 60 seconds) between IDLE and Intermediate (MIL). Determine throttle setting at highest VGBV.	a. VGBV is within limits. b. VGBV exceeds limits.	a. Go to step 31.

Table 1. Engine Vibration Analysis - PN VIC974FH (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
25. (continued)			**NOTE** • Do not exceed 4.5 mils. • Do not allow engine to operate between table 2 limits and do not exceed limit(s) for more than 60 seconds. b. Adjust throttle to obtain highest VGBV. Go to step 26.
26.	Turn FILTER MODE SELECTOR to TACHOMETER SELECTOR. Record N1 and N2 rpm.		
27.	Turn TACHOMETER SELECTOR to 1E1. Record N1 component of VGBV vibration.	a. N1 component within limit.	a. Go to step 28.
		b. N1 component exceeds limit.	b.1. Check test cell vibration instruments for accuracy. b.2. If instruments are accurate, terminate test. b.3. Troubleshoot engine per table 7.

Table 1. Engine Vibration Analysis - PN VIC974FH (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
28.	Turn TACHOMETER SELECTOR to TP. Record N2 component of VGBV vibration.	a. N2 component within limit.	a. Go to step 29.
		b. N2 component exceeds limit.	b.1. Check test cell vibration instruments for accuracy. b.2. If instruments are accurate, terminate test b.3. Troubleshoot engine per table 8.
29.	Turn TACHOMETER SELECTOR to 1.14-TP2. Record PTO component of VGBV vibration.	a. PTO component within limit.	a. Go to step 30.
		b. PTO component exceeds limit.	b. 1. Check test cell vibration intruments for accuracy. b.2. If instruments are accurate, terminate test. Replace gearbox module.
30.	Turn FILTER MODE SELECTOR to OVERALL.		
31.	Move throttle to IDLE. Stabilize 5 minutes.		
32.	Shut down engine.		

Table 2. Vibration Analysis Limits - PN VIC974FH

Vibration	Overall	Component		
		N1 - 1E1	N2 - TP2	PTO - 1.14-TP2
VICV	3.1	3.1	1.2	-
VGBV	2.7	2.7	2.7	2.2
VDCH	2.2	1.7	2.2	-
VAP6 IDLE to 11000 N2 RPM	4.0	3.1	4.0	-
VAP6 Greater than 11000 N2 RPM	3.1	3.1	3.1	-

Table 3. Engine Vibration Analysis - Spectral Dynamics Model 4112

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
	CAUTION Perform engine rotation inspection before starting an engine with vibration anomaly.		
1.	Start engine in PRIMARY MODE.		
2.	Stabilize engine 5 minutes at IDLE.	Engine operation within limits.	Troubleshoot as required.
3.	Accelerate slowly (approximately 60 seconds) between IDLE and Intermediate (MIL). Determine throttle setting(s) at highest VICV, VDCH, VAP6, and VGBV.	a. All vibration within limits. b. Any vibration exceed limits.	a. Terminate test. Return engine to service. **NOTE** • Do not exceed 9.0 mils for VICV, VGBV, VAP6 and 5.0 mils for VDCH. • Do not allow engine to operate between table 4 limits and do not exceed limit(s) for more than 60 seconds. b. Adjust throttle to obtain highest out-of-limit vibration. Perform steps 4 through 7 for each out-of-limit vibration parameter.
4.	Turn CHANNEL SELECTOR to vibration channel being checked.		

Table 3. Engine Vibration Analysis - Spectral Dynamics Model 4112 (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
5.	Turn TACHOMETER RATIO SELECTOR to N1. Record N1 component of vibration.	a. N1 component within limits.	a. Go to step 6.
		b. N1 component out of limits for any following channels: VICV,VGBV,VDCH,VAP6	b. Check test cell instruments for accuracy. If accurate, terminate test. b.1. Troubleshoot engine per table 7.
6.	Turn TACHOMETER RATIO SELECTOR to N2. Record N2 component of vibration.	a. N2 component within limits.	a. Go to step 7.
		b. N2 component out of limits for any of the following channels: VICV,VGBV,VDCH,VAP6	b. Check test cell instruments for accuracy. If accurate, terminate test. b.1. Troubleshoot engine per table 8.
7.	Turn TACHOMETER RATIO SELECTOR to ACCESS and record PTO component of VGBV vibration.	a. PTO component within limits. b. PTO component out-of-limits.	a. Go to step 8. b.1. Check test cell vibration instruments for accuracy. b.2. If instruments are accurate, terminate test. Replace gearbox module.
8.	Move throttle to IDLE. Stabilize 5 minutes.		
9.	Shut down engine.		

Table 4. Vibration Analysis Limits - Spectral Dynamics Model 4112

Vibration		Overall	Component		
			N1	N2	Access PTO
VICV		6.2	6.2	2.4	-
VGBV		5.4	5.4	5.4	4.4
VDCH		4.4	3.4	4.4	-
VAP6	IDLE to 11000 N2 RPM	8.0	6.2	8.0	-
VAP6	Greater than 11000 N2 RPM	6.2	6.2	6.2	-

Table 5. Engine Vibration Analysis - TRIGTEK Model 623B

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
CAUTION Perform engine rotation inspection before starting an engine with vibration anomaly.			
1.	Start engine in PRIMARY MODE.		
2.	Stabilize engine 5 minutes at IDLE.	Engine operation within limits.	Troubleshoot as required.
3.	Accelerate slowly (approximately 60 seconds) between IDLE and Intermediate (MIL). Determine throttle setting(s) at highest VICV, VDCH, VAP6, and VGBV.	a. All vibration within limits. b. Any vibration exceed limits.	a. Terminate test. Return engine to service. NOTE • Do not exceed 9.0 mils for VICV, VGBV, VAP6 and 5.0 mils for VDCH. • Do not allow engine to operate between table 4 limits and do not exceed limit(s) for more than 60 seconds. b. Adjust throttle to obtain highest out-of-limit vibration. Perform steps 4 through 7 for each out-of-limit vibration parameter.
4.	Turn CHANNEL SELECTOR to vibration channel being checked.		

Table 5. Engine Vibration Analysis - TRIGTEK Model 623B (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
5.	Turn TACHOMETER RATIO SELECTOR to N1. Record N1 component of vibration.	a. N1 component within limits.	a. Go to step 6.
		b. N1 component out of limits for any following channels: VICV,VGBV,VDCH,VAP6	b. 1. Check test cell instruments for accuracy. If accurate, terminate test.
			b.2. Troubleshoot engine per table 7.
6.	Turn TACHOMETER RATIO SELECTOR to N2. Record N2 component of vibration.	a. N2 component within limits.	a. Go to step 7.
		b. N2 component out of limits for any of the following channels: VICV,VGBV,VDCH,VAP6	b. Check test cell instruments for accuracy. If accurate, terminate test.
			b.2. Troubleshoot engine per table 8.
7.	Determine the PTO (Gearbox) component of vibration and record.	a. PTO component within limits.	a. Go to step 8.

Table 5. Engine Vibration Analysis - TRIGTEK Model 623B (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
	NOTE Ensure HZ/RPM/PERCENT toggle switch is in RPM position. Note N2 RPM.		
	Place TACHOMETER RATIO SELECTOR to MANUAL. PTO component can be displayd by multipying N2 RPM value by 1.14 then dial resultant value on MANUAL dial.	b. PTO component out-of-limits.	b.1. Check test cell vibration instruments for accuracy. b.2. If instruments are accurate, terminate test. Replace gearbox module.
8.	Move throttle to IDLE. Stabilize 5 minutes.		
9.	Shut down engine.		

Table 6. Vibration Analysis Limits - TRIGTEK Model 623B

Vibration		Overall	Component		
			N1	N2	Access PTO
VICV		6.2	6.2	2.4	-
VGBV		5.4	5.4	5.4	4.4
VDCH		4.4	3.4	4.4	-
VAP6	IDLE to 11000 N2 RPM	8.0	6.2	8.0	-
VAP6	Greater than 11000 N2 RPM	6.2	6.2	6.2	-

Table 7. Low Rotor Vibration Out-Of-Limits

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
1.	Check test stand vibration instruments for installation and accuracy.	a. Vibration instruments properly installed and reading accurate.	a. Go to step 2.
		b. Vibration instruments installed loosely;accelerometer or accelerometer cable causing inaccurate reading.	b. Correct vibration instrumentation repeat vibration analysis.
2.	Inspect gearbox and oil pump chip detectors per WP 301 00.	a. Chip detectors okay.	a. Go to step 3.
		b. Metal particles beyond T.O. limits present on chip detectors.	b. Isolate cause for chips and repair engine,as required.
3.	Review JOAP records. (DD Form 2037) Refer to T.O. 33-1-37.	a. JOAP within limits.	a. Go to step 4.
		b. Wearmetals exceed JOAP limits.	b. Isolate cause for wearmetal out-of-limits and repair engine, as required.
4.	Visually inspect fan inlet and LPT for FOD.	a. No damaged noted.	a. Go to step 5.
		b. Damage noted.	b. Repair, as required.
5.	Borescope inspect fan inlet and LPT for damage. Refer to T.O. 2J-F100-53-5, WP 020 00.	a. No damaged noted.	a. Go to step 6.
		b. Damage noted.	b. Repair, as required.

Table 7. Low Rotor Vibration Out-Of-Limits (Continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
6.	Inspect N1 Rotor for freedom of rotation. Refer to T.O. 2J-F100-53-5, WP 006 00.	a. Freedom of rotation check okay.	a. Go to step 7.
		b. Rubbing, scraping, or unusual noise present.	b. Isolate to fan inlet or LPT, and repair as required.
7.	Determine which vibration acceleromter was out-of-limits.	a. VICV or VGBV N1 component out-of-limits.	a. Go to step 8
		b. VAP6 or VDCH N1 component out-of limits.	b. Terminate test. Replace LPT.
8.	Determine which vibration analyzer was used to record vibration data.	a. PN VIC974FH	a. Go to step 8.a.
		b. Spectral Dynamics Model 4112, or Trigtek Model 623B.	b. Go to step 8.b.

Table 7. Low Rotor Vibration Out-Of-Limits (Continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication

CAUTION

To avoid damage to equipment, do not operate engine over DO NOT EXCEED limits defined in this work package. If unable to calculate NLP due to DO NOT EXCEED limits, go to step 9.

NOTE

- VSEC=VICV N1 component at Intermediate (MIL) power in Secondary Control Mode
- VPRI=VICV N1 component at Intermediate (MIL) power in Primary Control Mode
- Ensure NLP is caculated properly and order of subtraction is correct. Take VSEC value and subtract VPRI value.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
8.a.	Calculate vibration Null Load Parameter (NLP) for PN VIC974FH vibration analyzer:		

$$NLP = \frac{(VSEC - VPRI)\ X\ (VSEC + VPRI)}{2}$$

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
		a. NLP greater than or equal to 3.0	a. Go to step 11.
		b. NLP less than 3.0	b. Go to step 9.
8.b.	Calculate vibration Null Load Parameter (NLP) for Spectral Dynamics Model 4112, or Trigtek Model 623B vibration analyzer:		

$$NLP = \frac{(VSEC - VPRI)\ X\ (VSEC + VPRI)}{8}$$

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
		a. NLP greater than or equal to 3.0	a. Go to step 11.
		b. NLP less than 3.0	b. Go to step 9.

Table 7. Low Rotor Vibration Out-Of-Limits (Continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
9.	Disassemble engine and rotate fan 180 degrees relative to LPT shaft. Repeat engine acceptance test per WP 212 00.	a. Vibration out-of-limits.	a. Go to step 10.
		b. Vibration within limits.	b. Return engine to service.
10.	Review troubleshooting activity to determine if LPT module has been previously replaced during vibration troubleshooting recently conducted per step 11.	a. LPT module not previously replace.	a. Go to step 11.
		b. LPT module replaced during current vibration troubleshooting.	b. Go to step 12.
11.	Disassemble engine and replace LPT. Repeat engine acceptance test per WP 212 00.	a. Vibration out-of-limits.	a. Go to step 12.
		b. Vibration within limits.	b. Return engine to service.
12.	Review troubleshooting activity to determine if fan inlet module was previously rotated during current vibration troubleshooting per step 9.	a. Fan inlet module not previously rotated.	a. Go to step 9.
		b. Fan inlet module rotated per step 14 during current vibration troubleshooting.	b. Go to step 13.

Table 7. Low Rotor Vibration Out-Of-Limits (Continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
13.	Disassemble engine. Replace fan inlet module. Repeat engine acceptance test per WP 212 00.	a. Vibration out-of-limits.	a. Terminmate test. Disassemble engine; remove and re-balance fan inlet and LPT modules. Replace No. 2 bearing coupling shaft.
		b. Vibration within limits.	b. Return engine to service.

Table 8. High Rotor Vibration Out-Of-Limits

Step	Procedure	Result	Corrective Action
1.	Check test stand vibration instruments for proper installation and accuracy.	a. Vibration instruments properly installed and reading accurate.	a. Go to step 2.
		b. Vibration instruments installed loosely; accelerometer or accelerometer cable causing inaccurate reading.	b. Correct vibration instrumentation repeat vibration analysis.
2.	Inspect gearbox and oil pump chip detectors per WP 301 00.	a. Chip detectors okay.	a. Go to step 3.
		b. Metal particles beyond T.O. limits present on chip detectors.	b. Isolate cause for chips and repair engine, as required.
3.	Review JOAP records. (DD Form 2037) Refer to T.O. 33-1-37.	a. JOAP within limits.	a. Go to step 4.
			b. Isolate cause for wearmetal out-of-limits and repair engine as required.

Table 8. High Rotor Vibration Out-Of-Limits (continued)

Step	Procedure	Result	Corrective Action
4.	Borescope inspect HPC and HPT for damage. Refer to T.O. 2J-F100-53-5, WP 020 00.	a. No damage noted.	a. Go to step 5.
		b. Damage noted.	b. Repair as required.
5.	Inspect N2 rotor for freedom of rotation per WP 209 00.	a. Freedom of rotation check okay.	a. Go to step 6.
		b. Rubbing, scraping, or unusual noise present.	b. Isolate to HPC or HPT and repair as required.
6.	Disassemble engine and rotate HPT 180 degrees relative to HPC. Repeat engine acceptance test per WP 212 00.	a. Vibration out-of-limits.	a. Go to step 7.
		b. Vibration within limits.	b. Return engine to service.
7.	Determine which vibration accelerometer was out-of-limits.	a. VICV or VGBV N2 component out-of-limits.	a. Terminate test. Replace core module.
		b. VAP6 or VDCH N2 component out-of limits.	b. Terminate test. Replace HPT module.

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE SHUTDOWN

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Oil System Servicing	WP 109 00
Engine Operation Limits	WP 205 00
Emergency Procedures	WP 209 00
Engine Troubleshooting - General	WP 501 00
Engine	T.O. 2J-F100-53-5

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains engine shutdown procedures.

2. ENGINE SHUTDOWN.

(See Table 1.)

a. Perform procedures in table 1 for normal engine shutdown.

b. N_1 and N_2 rotation inspections are in paragraph 3.

c. Review emergency shutdown procedures in WP 209 00.

Table 1. Engine Shutdown

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
1.	Reduce engine speed to IDLE.		

NOTE

If engine is shut down without cool-down period, motor engine as soon as possible until FTIT is below 200°C (392°F).

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
2.	If engine has been operating above IDLE, stabilize 5 minutes at IDLE. If emergency shutdown is required, perform an engine rotation inspection before restart.	Visually inspect engine for leaks.	
3.	Move throttle to CUTOFF.	N_1 and N_2 coast down normally.	Perform engine rotation inspection.
4.	Engage FAC FUEL CLOSED and CELL FUEL CLOSED push button switches.		
5.	Turn EHR/EDU POWER off after engine spooldown.	EHR/EDU POWER and EDU READY lights extinquish.	Check test cell wiring.

Table 1. Engine Shutdown (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
6.	Review EDU data.	No faults indicated.	Troubleshoot faults.
7.	Check oil tank sight glass level within 30 minutes after shutdown. Record level.	Oil level within limits.	a. Service oil system. b. Record servicing in engine records. c. Troubleshoot oil consumption anomaly.

WARNING

- Post shutdown auto-ignition in engine tailpipe may occur within 10 minutes after engine shutdown and may be indicated by a mild bang. Ignition may be followed by smoke, fumes, and/or small fire in combustion-turbine area. Avoid engine exhaust and inlet areas for 10 minutes following engine shutdown.
- Auto-ignition does not cause damage to engine. If a post shutdown fire occurs, engine may be motored with starter for approximately 1 minute to extinguish fire.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
8.	If no further testing required, perform posttest procedures.		

3. ENGINE ROTATION INSPECTION.

(See Figure 1.)

NOTE

- Perform N_2 rotation inspection if N_2 rotor seizure or unusual noise occurs during engine shutdown.
- This procedure may be performed with engine installed on test stand or ALC 3000E transportation trailer.
- If engine is shutdown for any reason before completion of Core Run In procedure, temporary N_2 rotor seizure may occur. If seizure occurs it is not detrimental to the engine and the rotor will free as the engine thermally equalizes (typically less than 2 hours). Further engine inspection and disassembly is not required when seizure clears.

a. Rotate N_2 rotor using standard 1 5/8-inch open-end wrench on remote gearbox driveshaft coupling hex nut.

b. Check N_1 rotor by turning fan inlet blades by hand.

c. If engine rotates freely and without any unusual noise, no damage has occurred to N_1 or N_2rotors.

NOTE

N_2 rotor seizure may occur in engine or gearbox.

d. If N_1 or N_2 rotors cannot be rotated or make unusual noise, further engine inspection and disassembly is required per T.O. 2J-F100-53-5.

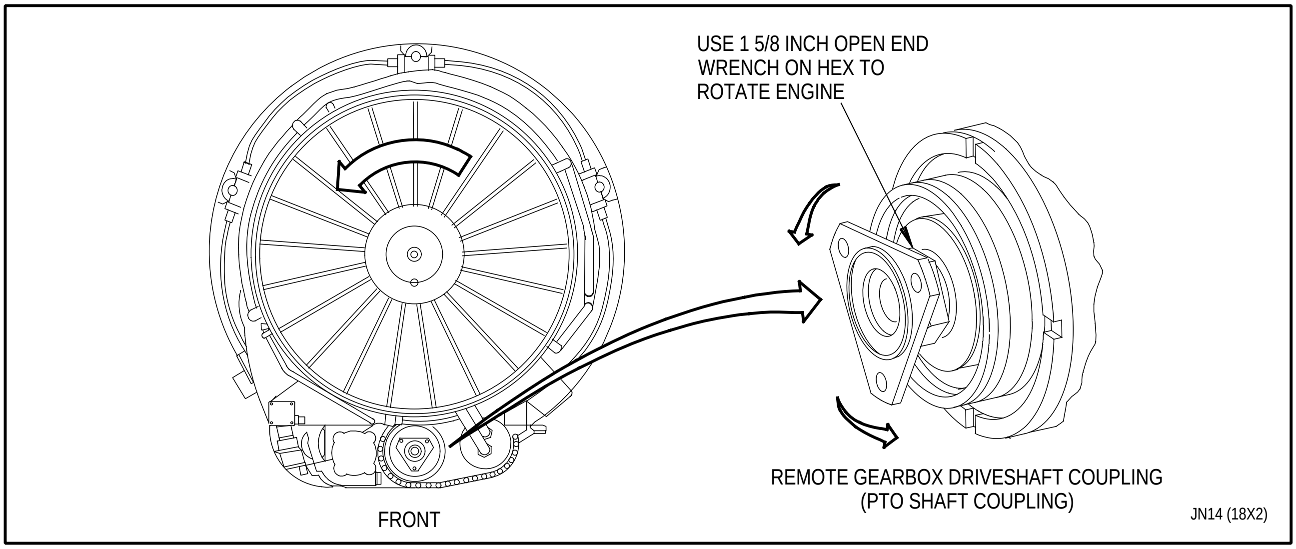


Figure 1. Rotating N_2 Rotor Using Wrench

4. FOLLOW-ON MAINTENANCE.

a. If no further testing is required, perform engine posttest procedures per WP 300 00.

WORK PACKAGE

TECHNICAL PROCEDURES

REFERENCE TEST DATA

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 14

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 13	0				
14 Blank	0				

REFERENCE MATERIAL REQUIRED

None

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains reference material, conversion tables, and temperature/pressure correction tables which may be required during engine test.

2. DATA TABLES.

(See Tables 1 through 4.)

Table 1. Temperature Correction Factors (θt And $\sqrt{\theta t}$)

TEMP - C	θt	$\sqrt{\theta t}$
-40	0.80913	0.89951
-39	0.81260	0.90144
-38	0.81607	0.90336
-37	0.81954	0.90528
-36	0.82301	0.90720
-35	0.82648	0.90911
-34	0.82995	0.91102
-33	0.83342	0.91292
-32	0.83689	0.91482
-31	0.84036	0.91671
-30	0.84383	0.91860
-29	0.84730	0.92049
-28	0.85077	0.92237
-27	0.85424	0.92425
-26	0.85771	0.92613
-25	0.86118	0.92800
-24	0.86465	0.92987
-23	0.86812	0.93173
-22	0.87159	0.93359
-21	0.87506	0.93545
-20	0.87854	0.93730
-19	0.88201	0.93915
-18	0.88548	0.94100
-17	0.88895	0.94284
-16	0.89242	0.94468
-15	0.89589	0.94651
-14	0.89936	0.94834
-13	0.90283	0.95017
-12	0.90630	0.95200
-11	0.90977	0.95382
-10	0.91324	0.95564
-9	0.91671	0.95745
-8	0.92018	0.95926
-7	0.92365	0.96107
-6	0.92712	0.96287
-5	0.93059	0.96467
-4	0.93406	0.96647
-3	0.93753	0.96826
-2	0.94100	0.97005
-1	0.94447	0.97184
0	0.94794	0.97362
1	0.95141	0.97540
2	0.95488	0.97718
3	0.95835	0.97896
4	0.96183	0.98073
5	0.96530	0.98249
6	0.96877	0.98426
7	0.97224	0.98602
8	0.97571	0.98778
9	0.97918	0.98953
10	0.98265	0.99129
11	0.98612	0.99303
12	0.98959	0.99478
13	0.99306	0.99652
14	0.99653	0.99826
15	1.00000	1.00000
16	1.00347	1.00173
17	1.00694	1.00346
18	1.01041	1.00519
19	1.01388	1.00692
20	1.01735	1.00864
21	1.02082	1.01036
22	1.02429	1.01207
23	1.02776	1.01379
24	1.03123	1.01550
25	1.03470	1.01720
26	1.03817	1.01891
27	1.04164	1.02061
28	1.04511	1.02231
29	1.04858	1.02400
30	1.05206	1.02570
31	1.05553	1.02739
32	1.05900	1.02908
33	1.06247	1.03076
34	1.06594	1.03244
35	1.06941	1.03412
36	1.07288	1.03580
37	1.07635	1.03747
38	1.07982	1.03941
39	1.08329	1.04081
40	1.08676	1.04248
41	1.09023	1.04414
42	1.09370	1.04580
43	1.09717	1.04746
44	1.10064	1.04911
45	1.10411	1.05077
46	1.10758	1.05242
47	1.11105	1.05406
48	1.11452	1.05571
49	1.11799	1.05735
50	1.12146	1.05899
51	1.12493	1.06063
52	1.12840	1.06226
53	1.13188	1.06390
54	1.13535	1.06553
55	1.13882	1.06715
56	1.14229	1.06878
57	1.14576	1.07040
58	1.14923	1.07202
59	1.15270	1.07364
60	1.15617	1.07525
61	1.15964	1.07687
62	1.16311	1.07847
63	1.16658	1.08008
64	1.17005	1.08169
65	1.17352	1.08329
66	1.17699	1.08489
67	1.18046	1.08649
68	1.18393	1.08809
69	1.18740	1.08968
70	1.19087	1.09127
71	1.19434	1.09286
72	1.19781	1.09445
73	1.20128	1.09603
74	1.20475	1.09761
75	1.20822	1.09919
76	1.21169	1.10077
77	1.21517	1.10235
78	1.21864	1.10392
79	1.22211	1.10549
80	1.22558	1.10706
81	1.22905	1.10862
82	1.23252	1.11019
83	1.23599	1.11175
84	1.23946	1.11331
85	1.24293	1.11487
86	1.24640	1.11642
87	1.24987	1.11798
88	1.25334	1.11953
89	1.25681	1.12108
90	1.26028	1.12262
91	1.26375	1.12417
92	1.26722	1.12571
93	1.27069	1.12725
94	1.27416	1.12879
95	1.27763	1.13032
96	1.28110	1.13186
97	1.28457	1.13339
98	1.28804	1.13492
99	1.29151	1.13645
100	1.29498	1.13797

Table 1. Temperature Correction Factors (θt And $\sqrt{\theta t}$) (continued)

TEMP - C	θt	$\sqrt{\theta t}$	TEMP - C	θt	$\sqrt{\theta t}$	TEMP - C	θt	$\sqrt{\theta t}$
101	1.29846	1.13950	125	1.38175	1.17548	149	1.46504	1.21039
102	1.30193	1.14102	126	1.38522	1.17695	150	1.46851	1.21182
103	1.30540	1.14254	127	1.38869	1.17842	151	1.47198	1.21325
104	1.30887	1.14406	128	1.39216	1.17990	152	1.47545	1.21468
105	1.31234	1.14557	129	1.39563	1.18137	153	1.47892	1.21611
106	1.31581	1.14709	130	1.39910	1.18283	154	1.48239	1.21753
107	1.31928	1.14860	131	1.40257	1.18430	155	1.48586	1.21896
108	1.32275	1.15011	132	1.40604	1.18577	156	1.48933	1.22038
109	1.32622	1.15162	133	1.40951	1.18723	157	1.49280	1.22180
110	1.32969	1.15312	134	1.41298	1.18869	158	1.49627	1.22322
111	1.33316	1.15462	135	1.41645	1.19015	159	1.49974	1.22464
112	1.33663	1.15613	136	1.41992	1.19160	160	1.50321	1.22606
113	1.34010	1.15763	137	1.42339	1.19306	161	1.50668	1.22747
114	1.34357	1.15913	138	1.42686	1.19451	162	1.51015	1.22888
115	1.34704	1.16062	139	1.43033	1.19596	163	1.51362	1.23029
116	1.35051	1.16212	140	1.43380	1.19741	164	1.51709	1.23170
117	1.35398	1.16361	141	1.43727	1.19886	165	1.52056	1.23311
118	1.35745	1.16510	142	1.44074	1.20031	166	1.52403	1.23452
119	1.36092	1.16659	143	1.44421	1.20175	167	1.52750	1.23592
120	1.36439	1.16807	144	1.44768	1.20320	168	1.53097	1.23732
121	1.36786	1.16956	145	1.45115	1.20464	169	1.53444	1.23873
122	1.37133	1.17104	146	1.45462	1.20608	170	1.53791	1.24013
123	1.37480	1.17252	147	1.45809	1.20752	171	1.54138	1.24152
124	1.37827	1.17400	148	1.46157	1.20895			

NOTE: $\theta t(^\circ C) + 273.15$
288.15

Table 2. Temperature Conversion Chart

°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
-54	-65.2	-7	19.4	40	104.0	87	188.6	134	273.2
-53	-63.4	-6	21.2	41	105.8	88	190.4	135	275.0
-52	-61.6	-5	23.0	42	107.0	89	192.2	136	276.8
-51	-59.8	-4	24.8	43	109.4	90	194.0	137	278.5
-50	-58.0	-3	26.6	44	111.2	91	195.8	138	280.4
-49	-56.2	-2	28.4	45	113.0	92	197.6	139	282.2
-48	-54.4	-1	30.2	46	114.8	93	199.4	140	284.0
-47	-52.6	0	32.0	47	116.6	94	201.2	141	285.8
-46	-50.8	1	33.8	48	118.4	95	203.0	142	287.6
-45	-49.0	2	35.6	49	120.2	96	204.8	143	289.4
-44	-47.2	3	37.4	50	122.0	97	206.6	144	291.2
-43	-45.2	4	39.2	51	123.8	98	208.4	145	293.0
-42	-43.6	5	41.0	52	125.6	99	210.2	146	294.8
-41	-41.8	6	42.8	53	127.4	100	212.0	147	296.6
-40	-40.0	7	44.6	54	129.2	101	213.8	148	298.4
-39	-38.2	8	46.4	55	131.0	102	215.6	149	300.2
-38	-36.4	9	48.2	56	132.8	103	217.4	150	302.0
-37	-34.6	10	50.0	57	134.6	104	219.2	151	303.8
-36	-32.8	11	51.8	58	136.4	105	221.0	152	305.6
-35	-31.0	12	53.6	59	138.2	106	222.8	153	307.4
-34	-29.2	13	55.4	60	140.0	107	224.6	154	309.2
-33	-27.4	14	57.2	61	141.8	108	226.4	155	311.0
-32	-25.6	15	59.0	62	143.6	109	228.2	156	312.8
-31	-23.8	16	60.8	63	145.4	110	230.0	157	314.6
-30	-22.0	17	62.6	64	147.2	111	231.8	158	316.4
-29	-20.2	18	64.4	65	149.0	112	233.6	159	318.2
-28	-18.4	19	66.2	66	150.8	113	235.4	160	320.0
-27	-16.6	20	68.0	67	152.6	114	237.2	161	321.8
-26	-14.8	21	69.8	68	154.4	115	239.0	162	323.6
-25	-13.0	22	71.6	69	156.2	116	240.8	163	325.4
-24	-11.2	23	73.4	70	158.0	117	242.6	164	327.2
-23	-9.4	24	75.2	71	159.8	118	244.4	165	329.0
-22	-7.6	25	77.0	72	161.6	119	246.2	166	330.8
-21	-5.8	26	78.8	73	163.4	120	248.0	167	332.6
-20	-4.0	27	80.6	74	165.2	121	249.8	168	334.4
-19	-2.2	28	82.4	75	167.0	122	251.6	169	336.2
-18	-0.4	29	84.6	76	168.0	123	253.4	170	338.0
-17	1.4	30	86.0	77	170.6	124	255.2	171	339.8
-16	3.2	31	87.8	78	172.4	125	257.0	172	341.6
-15	5.0	32	89.6	79	174.2	126	258.8	173	343.4
-14	6.8	33	91.4	80	176.0	127	260.6	174	345.2
-13	8.6	34	93.2	81	177.8	128	262.4	175	347.0
-12	10.4	35	95.0	82	179.6	129	264.2	176	348.8
-11	12.2	36	96.8	83	181.4	130	266.0	177	350.6
-10	14.0	37	98.6	84	183.2	131	267.8	178	352.4
-9	15.8	38	100.4	85	185.0	132	269.6	179	354.2
-8	17.6	39	102.2	86	186.8	133	271.4	180	356.0

Table 2. Temperature Conversion Chart (continued)

°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
181	357.8	227	440.6	365	689.0	595	1103.0	825	1517.0
182	359.6	228	442.4	370	698.0	600	1112.0	830	1526.0
183	361.4	229	444.2	375	707.0	605	1121.0	835	1535.0
184	363.2	230	446.0	380	716.0	610	1130.0	840	1544.0
185	365.0	231	447.8	385	725.0	615	1139.0	845	1553.0
186	366.8	232	449.6	390	734.0	620	1148.0	850	1562.0
187	368.6	233	451.4	395	743.0	625	1157.0	855	1571.0
188	370.4	234	453.2	400	752.0	630	1166.0	860	1580.0
189	372.2	235	455.0	405	761.0	635	1175.0	865	1589.0
190	374.0	236	456.8	410	770.0	640	1184.0	870	1598.0
191	375.8	237	458.6	415	779.0	645	1193.0	875	1607.0
192	377.6	238	460.4	420	788.0	650	1202.0	880	1616.0
193	379.4	239	462.2	425	797.0	655	1211.0	885	1625.0
194	381.2	240	464.0	430	806.0	660	1220.0	890	1634.0
195	383.0	241	465.8	435	815.0	665	1229.0	895	1643.0
196	384.8	242	467.6	440	824.0	670	1238.0	900	1652.0
197	386.6	243	469.4	445	833.0	675	1247.0	905	1661.0
198	388.4	244	471.2	450	842.0	680	1256.0	910	1670.0
199	390.2	245	473.0	455	851.0	685	1265.0	915	1679.0
200	392.0	246	474.8	460	860.0	690	1274.0	920	1688.0
201	393.8	247	476.6	465	869.0	695	1283.0	925	1697.0
202	395.6	248	478.4	470	878.0	700	1292.0	930	1706.0
203	397.4	249	480.2	475	887.0	705	1301.0	935	1715.0
204	399.2	250	482.0	480	896.0	710	1310.0	940	1724.0
205	401.0	255	491.0	485	905.0	715	1319.0	945	1733.0
206	402.8	260	500.0	490	914.0	720	1328.0	950	1742.0
207	404.6	265	509.0	495	923.0	725	1337.0	955	1751.0
208	406.4	270	518.0	500	932.0	730	1346.0	960	1760.0
209	408.2	275	527.0	505	941.0	735	1355.0	965	1769.0
210	410.0	280	536.0	510	950.0	740	1364.0	970	1778.0
211	411.8	285	545.0	515	959.0	745	1373.0	975	1787.0
212	413.6	290	554.0	520	968.0	750	1382.0	980	1796.0
213	415.4	295	563.0	525	977.0	755	1391.0	985	1805.0
214	417.2	300	572.0	530	986.0	760	1400.0	990	1814.0
215	419.0	305	581.0	535	995.0	765	1409.0	995	1823.0
216	420.8	310	590.0	540	1004.0	770	1418.0	1000	1832.0
217	422.6	315	599.0	545	1013.0	775	1427.0	1005	1841.0
218	424.4	320	608.0	550	1022.0	780	1436.0	1010	1850.0
219	426.2	325	617.0	555	1031.0	785	1445.0	1015	1859.0
220	428.0	330	626.0	560	1040.0	790	1454.0	1020	1868.0
221	429.8	335	635.0	565	1049.0	795	1463.0	1025	1877.0
222	431.6	340	644.0	570	1058.0	800	1472.0	1030	1886.0
223	433.4	345	653.0	575	1067.0	805	1481.0	1035	1895.0
224	435.2	350	662.0	580	1076.0	810	1490.0	1040	1904.0
225	437.0	355	671.0	585	1085.0	815	1499.0	1045	1913.0
226	438.8	360	680.0	590	1094.0	820	1508.0		

Table 3. Pressure Conversion Chart

psi	in. Hg.	psi	in. Hg.	psi	in. Hg.	psi	in. Hg.	psi	in. Hg.
1.0	2.0	20.0	40.7	39.0	79.4	58.0	118.1	77.0	156.8
1.5	3.1	20.5	41.7	39.5	80.4	58.5	119.1	77.5	157.8
2.0	4.1	21.0	42.8	40.0	81.4	59.0	120.1	78.0	158.8
2.5	5.1	21.5	43.8	40.5	82.5	59.5	121.1	78.5	159.8
3.0	6.1	22.0	44.8	41.0	83.5	60.0	122.2	79.0	160.8
3.5	7.1	22.5	45.8	41.5	84.5	60.5	123.2	79.5	161.9
4.0	8.1	23.0	46.8	42.0	85.5	61.0	124.2	80.0	162.9
4.5	9.2	23.5	47.8	42.5	86.5	61.5	125.2	80.5	163.9
5.0	10.2	24.0	48.9	43.0	87.5	62.0	126.2	81.0	164.9
5.5	11.2	24.5	49.9	43.5	88.6	62.5	127.3	81.5	165.9
6.0	12.2	25.0	50.9	44.0	89.6	63.0	128.3	82.0	167.0
6.5	13.2	25.5	51.9	44.5	90.6	63.5	129.3	82.5	168.0
7.0	14.3	26.0	52.9	45.0	91.6	64.0	130.3	83.0	169.0
7.5	15.3	26.5	54.0	45.5	92.6	64.5	131.3	83.5	170.0
8.0	16.3	27.0	55.0	46.0	93.7	65.0	132.3	84.0	171.0
8.5	17.3	27.5	56.0	46.5	94.7	65.5	133.4	84.5	172.0
9.0	18.3	28.0	57.0	47.0	95.7	66.0	134.4	85.0	173.1
9.5	19.3	28.5	58.0	47.5	96.7	66.5	135.4	85.5	174.1
10.0	20.4	29.0	59.0	48.0	97.7	67.0	136.4	86.0	175.1
10.5	21.4	29.5	60.0	48.5	98.7	67.5	137.4	86.5	176.1
11.0	22.4	30.0	61.1	49.0	99.8	68.0	138.4	87.0	177.1
11.5	23.4	30.5	62.1	49.5	100.8	68.5	139.5	87.5	178.2
12.0	24.4	31.0	63.1	50.0	101.8	69.0	140.5	88.0	179.2
12.5	25.5	31.5	64.1	50.5	102.8	69.5	141.5	88.5	180.2
13.0	26.5	32.0	65.2	51.0	103.8	70.0	142.5	89.0	181.2
13.5	27.5	32.5	66.2	51.5	104.8	70.5	143.5	89.5	182.2
14.0	28.5	33.0	67.2	52.0	105.9	71.0	144.6	90.0	183.2
14.5	29.5	33.5	68.2	52.5	106.9	71.5	145.6	90.5	184.3
15.0	30.5	34.0	69.2	53.0	107.9	72.0	146.6	91.0	185.3
15.5	31.6	34.5	70.2	53.5	108.9	72.5	147.6	91.5	186.3
16.0	32.6	35.0	71.3	54.0	109.9	73.0	148.6	92.0	187.3
16.5	33.6	35.5	72.3	54.5	111.0	73.5	149.6	92.5	188.3
17.0	34.6	36.0	73.3	55.0	112.0	74.0	150.7	93.0	189.3
17.5	35.6	36.5	74.3	55.5	113.0	74.5	151.7	93.5	190.4
18.0	36.6	37.0	75.3	56.0	114.0	75.0	152.7	94.0	191.4
18.5	37.7	37.5	76.4	56.5	115.0	75.5	153.7	94.5	192.4
19.0	38.7	38.0	77.4	57.0	116.0	76.0	154.7	95.0	193.4
19.5	39.7	38.5	78.4	57.5	117.1	76.5	155.8	95.5	194.4

Table 3. Pressure Conversion Chart (continued)

psi	in. Hg.	psi	in. Hg.	psi	in. Hg.	psi	in. Hg.	psi	in. Hg.
96.0	195.5	130	264.7	168	342.0	206	419.4	244	496.8
96.5	196.5	131	266.7	169	344.1	207	421.5	245	498.8
97.0	197.5	132	268.8	170	346.1	208	423.5	246	500.9
97.5	198.5	133	270.8	171	348.2	209	425.5	247	502.9
98.0	199.5	134	272.8	172	350.2	210	427.6	248	504.9
98.5	200.5	135	274.9	173	352.2	211	429.6	249	507.0
99.0	201.6	136	276.9	174	354.3	212	431.6	250	509.0
99.5	202.6	137	278.9	175	356.3	213	433.7	251	511.0
100	203.6	138	281.0	176	358.3	214	435.7	252	513.1
101	205.6	139	283.0	177	360.4	215	437.7	253	515.1
102	207.7	140	285.0	178	362.4	216	439.8	254	517.1
103	209.7	141	287.1	179	364.4	217	441.8	255	519.2
104	211.7	142	289.1	180	366.5	218	443.8	256	521.2
105	213.8	143	291.1	181	368.5	219	445.9	257	523.3
106	215.8	144	293.2	182	370.6	220	447.9	258	525.3
107	217.9	145	295.2	183	372.6	221	450.0	259	527.3
108	219.9	146	297.3	184	374.6	222	452.0	260	529.4
109	221.9	147	299.3	185	376.7	223	454.0	261	531.4
110	224.0	148	301.3	186	378.7	224	456.1	262	533.4
111	226.0	149	303.4	187	380.7	225	458.1	263	535.5
112	228.0	150	305.4	188	382.8	226	460.1	264	537.5
113	230.1	151	307.4	189	384.8	227	462.2	265	539.5
114	232.1	152	309.5	190	386.8	228	464.2	266	541.6
115	234.1	153	311.5	191	388.9	229	466.2	267	543.6
116	236.2	154	313.5	192	390.9	230	468.3	268	545.6
117	238.2	155	315.6	193	392.9	231	470.3	269	547.7
118	240.2	156	317.6	194	395.0	232	472.4	270	549.7
119	242.3	157	319.7	195	397.0	233	474.4	271	551.8
120	244.3	158	321.7	196	399.1	234	476.4	272	553.8
121	246.4	159	323.7	197	401.1	235	478.5	273	555.8
122	248.4	160	325.8	198	403.1	236	480.5	374	557.9
123	250.4	161	327.8	199	405.2	237	482.5	275	559.9
124	252.5	162	329.8	200	407.2	238	484.6	276	561.9
125	254.5	163	331.9	201	409.2	239	486.6	277	564.0
126	256.5	164	333.9	202	411.3	240	488.6	278	566.0
127	258.6	165	335.9	203	413.3	241	490.7	279	568.0
128	260.6	166	338.0	204	415.3	242	492.7	280	570.0
129	262.6	167	340.0	205	417.4	243	494.7	281	572.1

Table 3. Pressure Conversion Chart (continued)

psi	in. Hg.	psi	in. Hg.	psi	in. Hg.	psi	in. Hg.	psi	in. Hg.
282	574.2	306	623.0	330	671.9	354	720.7	378	769.6
283	576.2	307	625.1	331	673.9	355	722.8	379	771.6
284	578.2	308	627.1	332	676.0	356	724.8	380	773.7
285	580.3	309	629.1	333	678.0	357	726.9	381	775.7
286	582.3	310	631.2	334	680.0	358	728.9	382	777.8
287	584.3	311	633.2	335	682.1	359	730.9	383	779.8
288	586.4	312	635.2	336	684.1	360	733.0	384	781.8
289	588.4	313	637.3	337	686.1	361	735.0	385	783.9
290	590.4	314	639.3	338	688.2	362	737.0	386	785.9
291	592.5	315	641.3	339	690.2	363	739.1	387	787.9
292	594.5	316	643.4	340	692.2	364	741.1	388	790.0
293	596.5	317	645.4	341	694.3	365	743.1	389	792.0
294	598.6	318	647.4	342	696.3	366	745.2	390	794.0
295	600.6	319	649.5	343	698.3	367	747.2	391	796.1
296	602.7	320	651.5	344	700.4	368	749.2	392	798.1
297	604.7	321	653.6	345	702.4	369	751.3	393	800.1
298	606.7	322	655.6	346	704.5	370	753.3	394	802.2
299	608.8	323	657.6	347	706.5	371	755.4	395	804.2
300	610.8	324	659.7	348	708.5	372	757.4	396	806.3
301	612.8	325	661.7	349	710.6	373	759.4	397	808.3
302	614.9	326	663.7	350	712.6	374	761.5	398	810.3
303	616.9	327	665.8	351	714.6	375	763.5	399	812.4
304	618.9	328	667.8	352	716.7	376	765.5	400	814.4
305	621.0	329	669.8	353	718.7	377	767.6		

Table 4. Pressure Correction Factors (δt2)

Pt2 (in. Hga)	δt2	Pt2 (in. Hga)	δt2	Pt2 (in. Hga)	δt2	Pt2 (in. Hga)	δt2	Pt2 (in. Hga)	δt2
25.00	.8356	25.46	.8509	25.92	.8663	26.38	.8817	26.84	.8970
25.01	.8359	25.47	.8513	25.93	.8666	26.39	.8820	26.85	.8974
25.02	.8362	25.48	.8516	25.94	.8670	26.40	.8824	26.86	.8977
25.03	.8366	25.49	.8519	25.95	.8673	26.41	.8827	26.87	.8981
25.04	.8369	25.50	.8523	25.96	.8676	26.42	.8830	26.88	.8984
25.05	.8372	25.51	.8526	25.97	.8680	26.43	.8834	26.89	.8987
25.06	.8376	25.52	.8529	25.98	.8683	26.44	.8837	26.90	.8991
25.07	.8379	25.53	.8533	25.99	.8686	26.45	.8840	26.91	.8994
25.08	.8382	25.54	.8536	26.00	.8690	26.46	.8844	26.92	.8997
25.09	.8386	25.55	.8539	26.01	.8693	26.47	.8847	26.93	.9001
25.10	.8389	25.56	.8543	26.02	.8696	26.48	.8850	26.94	.9004
25.11	.8392	25.57	.8546	26.03	.8700	26.49	.8854	26.95	.9007
25.12	.8396	25.58	.8549	26.04	.8703	26.50	.8857	26.96	.9011
25.13	.8399	25.59	.8553	26.05	.8706	26.51	.8860	26.97	.9014
25.14	.8402	25.60	.8556	26.06	.8710	26.52	.8864	26.98	.9017
25.15	.8406	25.61	.8559	26.07	.8713	26.53	.8867	26.99	.9021
25.16	.8409	25.62	.8563	26.08	.8716	26.54	.8870	27.00	.9024
25.17	.8412	25.63	.8566	26.09	.8720	26.55	.8874	27.01	.9027
25.18	.8416	25.64	.8570	26.10	.8723	26.56	.8877	27.02	.9031
25.19	.8419	25.65	.8573	26.11	.8727	26.57	.8880	27.03	.9034
25.20	.8422	25.66	.8576	26.12	.8730	26.58	.8884	27.04	.9037
25.21	.8426	25.67	.8580	26.13	.8733	26.59	.8887	27.05	.9041
25.22	.8429	25.68	.8583	26.14	.8737	26.60	.8890	27.06	.9044
25.23	.8433	25.69	.8586	26.15	.8740	26.61	8894	27.07	.9047
25.24	.8436	25.70	.8590	26.16	.8743	26.62	.8897	27.08	.9051
25.25	.8439	25.71	.8593	26.17	.8747	26.63	.8900	27.09	.9054
25.26	.8443	25.72	.8596	26.18	.8750	26.64	.8904	27.10	.9057
25.27	.8446	25.73	.8600	26.19	.8753	26.65	.8907	27.11	.9061
25.28	.8448	25.74	.8603	26.20	.8757	26.66	.8910	27.12	.9064
25.29	.8453	25.75	.8606	26.21	.8760	26.67	.8914	27.13	.9068
25.30	.8456	25.76	.8610	26.22	.8763	26.68	.8917	27.14	.9071
25.31	.8459	25.77	.8613	26.23	.8767	26.69	.8920	27.15	.9074
25.32	.8463	25.78	.8616	26.24	.8770	26.70	.8924	27.16	.9078
25.33	.8466	25.79	.8620	26.25	.8773	26.71	.8927	27.17	.9081
25.34	.8469	25.80	.8623	26.26	.8777	26.72	.8930	27.18	.9084
25.35	.8473	25.81	.8626	26.27	.8780	26.73	.8934	27.19	.9088
25.36	.8476	25.82	.8630	26.28	.8783	26.74	.8937	27.20	.9091
25.37	.8479	25.83	.8633	26.29	.8787	26.75	.8940	27.21	.9094
25.38	.8483	25.84	.8636	26.30	.8790	26.76	.8944	27.22	.9098
25.39	.8486	25.85	.8640	26.31	.8793	26.77	.8947	27.23	.9101
25.40	.8489	25.86	.8643	26.32	.8797	26.78	.8950	27.24	.9104
25.41	.8493	25.87	.8649	26.33	.8800	26.79	.8954	27.25	.9108
25.42	.8496	25.88	.8650	26.34	.8803	26.80	.8957	27.26	.9111
25.43	.8499	25.89	.8653	26.35	.8807	26.81	.8960	27.27	.9114
25.44	.8503	25.90	.8656	26.36	.8810	26.82	.8964	27.28	.9118
25.45	.8506	25.91	.8660	26.37	.8814	26.83	.8967	27.29	.9121

Table 4. Pressure Correction Factors (δt2) (continued)

Pt2 (in. Hga)	δt2	Pt2 (in. Hga)	δt2	Pt2 (in. Hga)	δt2	Pt2 (in. Hga)	δt2	Pt2 (in. Hga)	δt2
27.30	.9124	27.76	.9278	28.22	.9431	28.68	.9585	29.14	.9739
27.31	.9128	27.77	.9281	28.23	.9435	28.69	.9589	29.15	.9743
27.32	.9131	27.78	.9285	28.24	.9438	28.70	.9592	29.16	.9746
27.33	.9134	27.79	.9288	28.25	.9442	28.71	.9595	29.17	.9749
27.34	.9138	27.80	.9291	28.26	.9445	28.72	.9599	29.18	.9753
27.35	.9141	27.81	.9295	28.27	.9448	28.73	.9602	29.19	.9756
27.36	.9144	27.82	.9298	28.28	.9452	28.74	.9605	29.20	.9759
27.37	.9148	27.83	.9301	28.29	.9455	28.75	.9609	29.21	.9763
27.38	.9151	27.84	.9305	28.30	.9458	28.76	.9612	29.22	.9766
27.39	.9154	27.85	.9308	28.31	.9462	28.77	.9615	29.23	.9769
27.40	.9158	27.86	.9311	28.32	.9465	28.78	.9619	29.24	.9773
27.41	.9161	27.87	.9315	28.33	.9468	28.79	.9622	29.25	.9776
27.42	.9164	27.88	.9318	28.34	.9472	28.80	.9625	29.26	.9779
27.43	.9168	27.89	.9322	28.35	.9475	28.81	.9629	29.27	.9783
27.44	.9171	27.90	.9325	28.36	.9478	28.82	.9632	29.28	.9786
27.45	.9174	27.91	.9328	28.37	.9482	28.83	.9635	29.29	.9789
27.46	.9178	27.92	.9332	28.38	.9485	28.84	.9639	29.30	.9793
27.47	.9181	27.93	.9335	28.39	.9488	28.85	.9642	29.31	.9796
27.48	.9184	27.94	.9338	28.40	.9492	28.86	.9645	29.32	.9799
27.49	.9188	27.95	.9342	28.41	.9495	28.87	.9649	29.33	.9803
27.50	.9191	27.96	.9345	28.42	.9498	28.88	.9652	29.34	.9806
27.51	.9194	27.97	.9348	28.43	.9502	28.89	.9655	29.35	.9809
27.52	.9198	27.98	.9352	28.44	.9505	28.90	.9659	29.36	.9813
27.53	.9201	27.99	.9355	28.45	.9508	28.91	.9662	29.37	.9816
27.54	.9204	28.00	.9358	28.46	.9512	28.92	.9665	29.38	.9819
27.55	.9208	28.01	.9361	28.47	.9515	28.93	.9669	29.39	.9823
27.56	.9211	28.02	.9365	28.48	.9518	28.94	.9672	29.40	.9826
27.57	.9214	28.03	.9368	28.49	.9522	28.95	.9675	29.41	.9830
27.58	.9218	28.04	.9371	28.50	.9525	28.96	.9679	29.42	.9833
27.59	.9221	28.05	.9375	28.51	.9528	28.97	.9682	29.43	.9836
27.60	.9224	28.06	.9378	28.52	.9532	28.98	.9685	29.44	.9840
27.61	.9228	28.07	.9381	28.53	.9535	28.99	.9689	29.45	.9843
27.62	.9231	28.08	.9385	28.54	.9538	29.00	.9692	29.46	.9846
27.63	.9235	28.09	.9388	28.55	.9542	29.01	.9696	29.47	.9850
27.64	.9238	28.10	.9391	28.56	.9545	29.02	.9699	29.48	.9853
27.65	.9241	28.11	.9395	28.57	.9548	29.03	.9703	29.49	.9856
27.66	.9245	28.12	.9398	28.58	.9552	29.04	.9706	29.50	.9859
27.67	.9248	28.13	.9401	28.59	.9555	29.05	.9709	29.51	.9863
27.68	.9251	28.14	.9405	28.60	.9559	29.06	.9713	29.52	.9866
27.69	.9255	28.15	.9408	28.61	.9562	29.07	.9716	29.53	.9870
27.70	.9258	28.16	.9411	28.62	.9565	29.08	.9719	29.54	.9873
27.71	.9261	28.17	.9415	28.63	.9569	29.09	.9723	29.55	.9876
27.72	.9265	28.18	.9418	28.64	.9572	29.10	.9726	29.56	.9880
27.73	.9268	28.19	.9421	28.65	.9575	29.11	.9729	29.57	.9883
27.74	.9271	28.20	.9425	28.66	.9579	29.12	.9733	29.58	.9886
27.75	.9275	28.21	.9428	28.67	.9582	29.13	.9736	29.59	.9890

Table 4. Pressure Correction Factors (δt2) (continued)

Pt2 (in. Hga)	δt2	Pt2 (in. Hga)	δt2	Pt2 (in. Hga)	δt2	Pt2 (in. Hga)	δt2	Pt2 (in. Hga)	δt2
29.60	.9893	29.88	.9987	30.16	1.0080	30.44	1.0174	30.72	1.0267
29.61	.9896	29.89	.9990	30.17	1.0084	30.45	1.0177	30.73	1.0271
29.62	.9900	29.90	.9993	30.18	1.0087	30.46	1.0180	30.74	1.0274
29.63	.9903	29.91	.9997	30.19	1.0090	30.47	1.0184	30.75	1.0277
29.64	.9906	29.92	1.0000	30.20	1.0094	30.48	1.0187	30.76	1.0281
29.65	.9910	29.93	1.0003	30.21	1.0097	30.49	1.0191	30.77	1.0284
29.66	.9913	29.94	1.0007	30.22	1.0100	30.50	1.0194	30.78	1.0287
29.67	.9916	29.95	1.0010	30.23	1.0104	30.51	1.0197	30.79	1.0291
29.68	.9920	29.96	1.0013	30.24	1.0107	30.52	1.0201	30.80	1.0294
29.69	.9923	29.97	1.0017	30.25	1.0110	30.53	1.0204	30.81	1.0297
29.70	.9926	29.98	1.0020	30.26	1.0114	30.54	1.0207	30.82	1.0301
29.71	.9930	29.99	1.0023	30.27	1.0117	20.55	1.0211	30.83	1.0304
29.72	.9933	30.00	1.0027	30.28	1.0120	20.56	1.0214	30.84	1.0307
29.73	.9936	30.01	1.0030	30.29	1.0124	30.57	1.0217	30.85	1.0311
29.74	.9940	30.02	1.0033	30.30	1.0127	30.58	1.0221	30.86	1.0314
29.75	.9943	30.03	1.0037	30.31	1.0130	30.59	1.0224	30.87	1.0317
29.76	.9947	30.04	1.0040	30.32	1.0134	30.60	1.0227	30.88	1.0321
29.77	.9950	30.05	1.0043	30.33	1.0137	30.61	1.0231	30.89	1.0324
29.78	.9953	30.06	1.0047	30.34	1.0140	30.62	1.0234	30.90	1.0327
29.79	.9957	30.07	1.0050	30.35	1.0144	30.63	1.0237	30.91	1.0331
29.80	.9960	30.08	1.0053	30.36	1.0147	30.64	1.0241	30.92	1.0334
29.81	.9963	30.09	1.0057	30.37	1.0150	30.65	1.0244	30.93	1.0337
29.82	.9967	30.10	1.0060	30.38	1.0154	30.66	1.0247	30.94	1.0341
29.83	.9970	30.11	1.0064	30.39	1.0157	30.67	1.0251	30.95	1.0344
29.84	.9973	30.12	1.0067	30.40	1.0160	30.68	1.0254	30.96	1.0347
29.85	.9977	30.13	1.0070	30.41	1.0164	30.69	1.0257	30.97	1.0351
29.86	.9980	30.14	1.0074	30.42	1.0167	30.70	1.0261	30.98	1.0354
29.87	.9983	30.15	1.0077	30.43	1.0170	30.71	1.0264	30.99	1.0357
								31.00	1.0361

WORK PACKAGE

INTRODUCTION

ENGINE POSTTEST PROCEDURES

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 2

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	24				

1. INTRODUCTION.

This work package introduces work packages 300 00 through 499 00 which contain engine posttest procedures. The following work packages contain these procedures:

WP No.	Title
301 00	Engine Posttest Servicing
302 00	Engine Leak Check and Gaspath Inspection
303 00	Joint Oil Analysis Program (JOAP) Wearmetal Guidelines
304 00	Oil System Contamination
305 00	Engine Fuel System Contamination
306 00	Engine Preserving
307 00	Engine and AF 8624150 Test Cell Adapter Removal From AF 8624151 Thrust Frame
308 00	Oil System Flushing
309 00 through 399 00	Open
400 00	Introduction - Engine Undress Procedures
401 00	Test Tooling Removal From Engine (Undress)
402 00	Engine Transfer From AF 8624150 Test Cell Adapter To Shipping Support On ALC 3000E Transportation Trailer
403 00 through 499 00	Open

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE POSTTEST SERVICING

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

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1 - 2	24	5 - 7	0	11	24
3	0	8	24	12 Blank	24
4	24	9 - 10 Deleted	24	13 - 14	0

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Oil System Servicing	WP 109 00
Joint Oil Analysis Program (JOAP) Wearmetal Guidelines	WP 303 00
Oil System Contamination	WP 304 00
Engine Fuel System Contamination	WP 305 00
Engine Troubleshooting - General	WP 501 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Main Fuel Gear Pump	WP 005 00
Gearbox Module	T.O. 2J-F100-53-11
Gearbox Module - Preservation	WP 006 00
Joint Oil Analysis Program Laboratory Manual	T.O. 33-1-37

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
LOCKWIRE(0.032 INCH DIAMETER)	MS9226-04
OIL, LUBRICATING	MIL-L-7808J OR LATER REVISION OR MIL-L-23699C OR LATER REVISION
PETROLATUM (ALTERNATE TO OIL)	VV-P-236

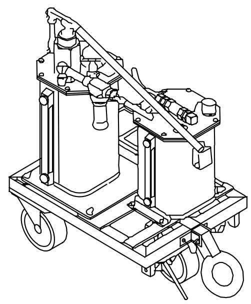
EXPENDABLE ITEMS

Nomenclature	Part Number	Quantity
Packing, preformed	NAS-1593-012	2
Packing, preformed	MS83248/1-023	1
Packing, preformed	MS83248/1-144	1

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Engine Posttest Servicing	
	Tank and Pump Unit - - - - - - - - - - - - - -	PMU 29/E (or equivalent)

ILLUSTRATED SUPPORT EQUIPMENT



PMU 29E –C

Figure T1. PMU 29/E Pump

1. INTRODUCTION.

a. This work package contains instructions for servicing an engine after test.

2. ENGINE POSTTEST SERVICING.

(See Figures 1 through 3 and Figures 6 through 8.)

CAUTION

Failure to service oil system as specified may cause improper servicing, engine oil leaks, and smoke during operation.

NOTE

- T.O. 33-1-37 Joint Oil Analysis Program (JOAP) applies except where specifically stated.
- Refer to WP 303 00 for JOAP wearmetal guidelines.

a. Within 30 minutes of engine shutdown take engine oil JOAP sample. (See figure 1.)

(1) Ensure engine is not overserviced during filling to overflow. Pump servicing cart slowly and keep oil lines connected until all oil flow has visibly stopped in the cart sight glass.

(2) Record engine oil levels in test cell log sheet, except where not possible such as on rebuilt engines or on engines drained for some other reason.

(3) Oil drained from engine shall not be reused for engine oil servicing.

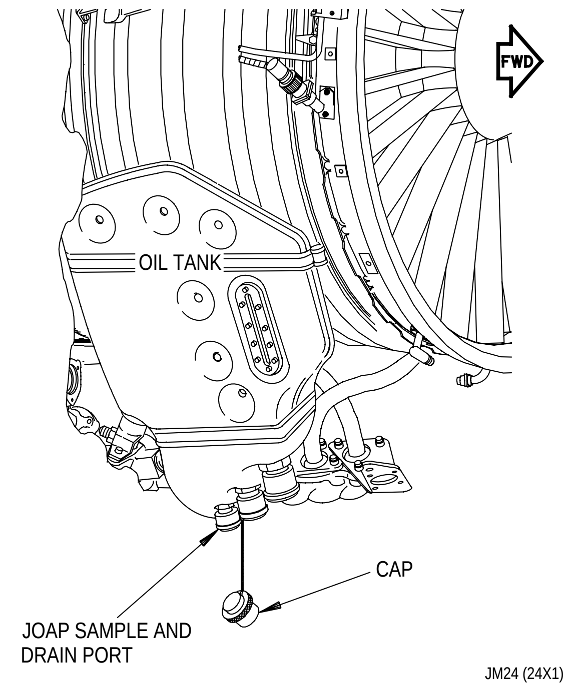


Figure 1. Joint Oil Analysis Program (JOAP) Sample Port

b. Remove and inspect chip detectors as follows: (See figures 2 and 3.)

NOTE

- Remove and install chip detectors one at a time. Carefully inspect detectors from all angles in well-lighted area.
- Do not touch inner end of detector to avoid disturbing metal particles before visual inspection is completed.
- If available, use edge of paper towel to draw oil from detector gap for better inspection.

(1) Push in on scalloped grip of chip detector and rotate one-quarter turn counterclockwise. Remove detector from housing.

(2) Replace chip detector packing if damaged. (Refer to T.O. 2J-F100-53-11, WP 006 00.)

(3) Visually inspect chip detectors for metal particles. If metal particles are present, further investigation is required. (Refer to WP 219 00 and T.O. 2J-F100-53-2, WP 008 00.)

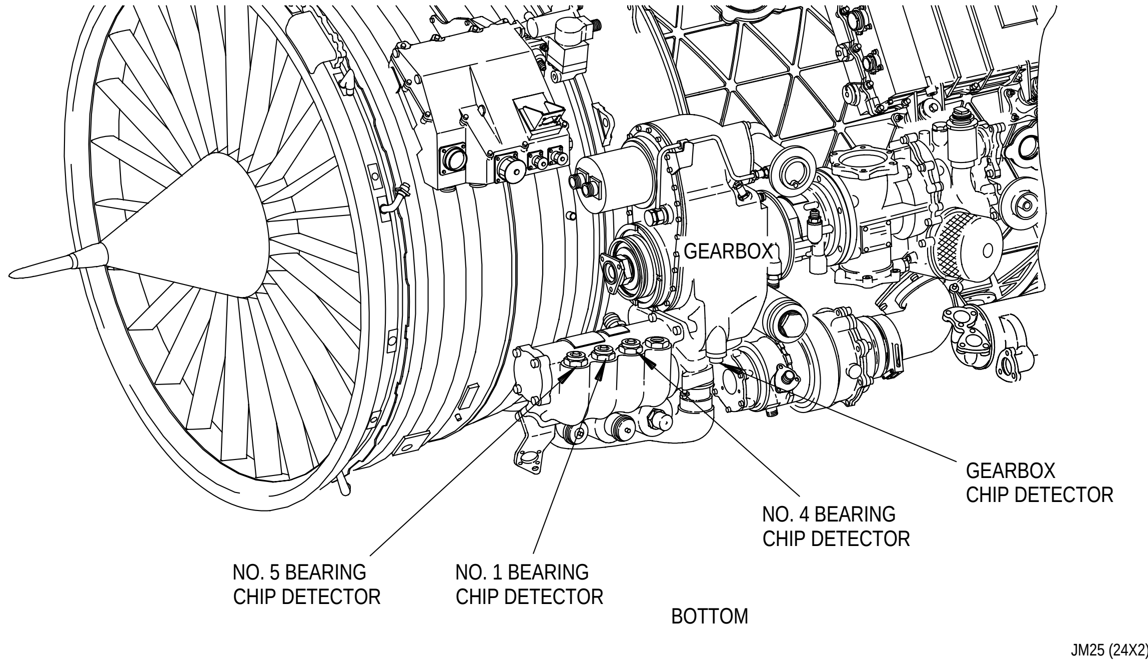


Figure 2. Chip Detector - Locations

WARNING

Exercise care when servicing oil system. Hot oil may drain from chip detector port, causing personnel injury.

CAUTION

Ensure chip detector is properly installed in positive locked position. If not properly installed, detector may fall out during engine operation causing oil loss and engine damage.

(4) Lubricate two PN NAS-1593-012 packings and stem of chip detector with light coat of MIL-L-7808 oil or VV-P-236 petrolatum. Install packings in grooves of chip detector. Install detector release and verify it is in positive lock position.

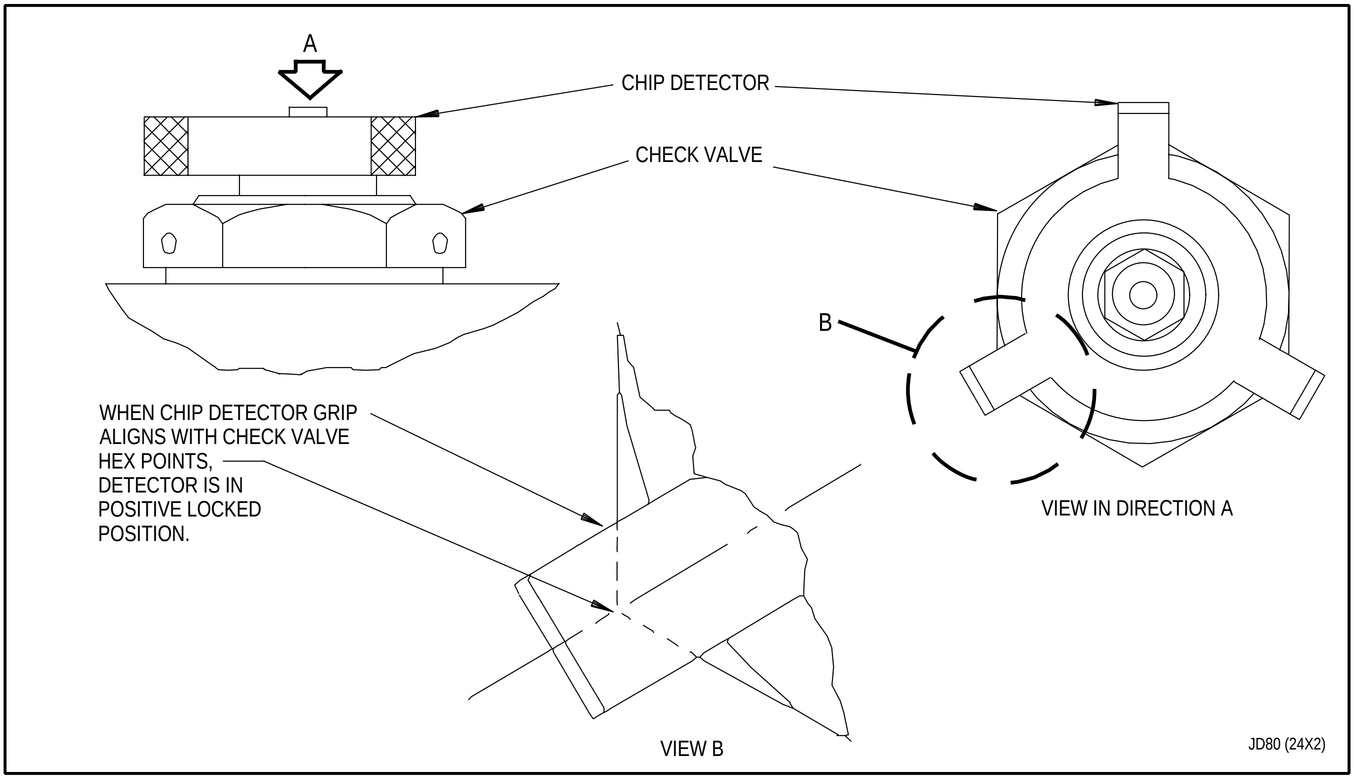


Figure 3. Chip Detector Installation - Alignment

NOTE

Oil level inspection and servicing are most accurate if performed within 5 to 15 minutes after engine shutdown.

c. Service oil system and determine oil consumption within 30 minutes of engine shutdown as follows:

(1) Read oil level in oil tank sight gage scale to nearest half-pint within 30 minutes of engine shutdown.

(a) If engine oil level is below oil sight gage in Area D within 30 minutes of engine shutdown, perform oil consumption check run per WP 219 00.

(2) Record level in test cell log sheet.

(3) Perform engine oil servicing per WP 109 00.

(4) through (13) deleted.

d. Check malfunction indicators. (See figure 6.)

(1) Oil filter: ΔP indicator will extend if there is excessive pressure drop across filter element due to clogging.

(a) If button is extended, refer to WP 304 00.

(2) Main fuel pump filter: ΔP indicator will extend if there is excessive pressure drop across filter element.

(a) If button is extended, refer to WP 305 00.

Figure 4. Deleted.

Figure 5. Deleted.

Pages 9 and 10 deleted.

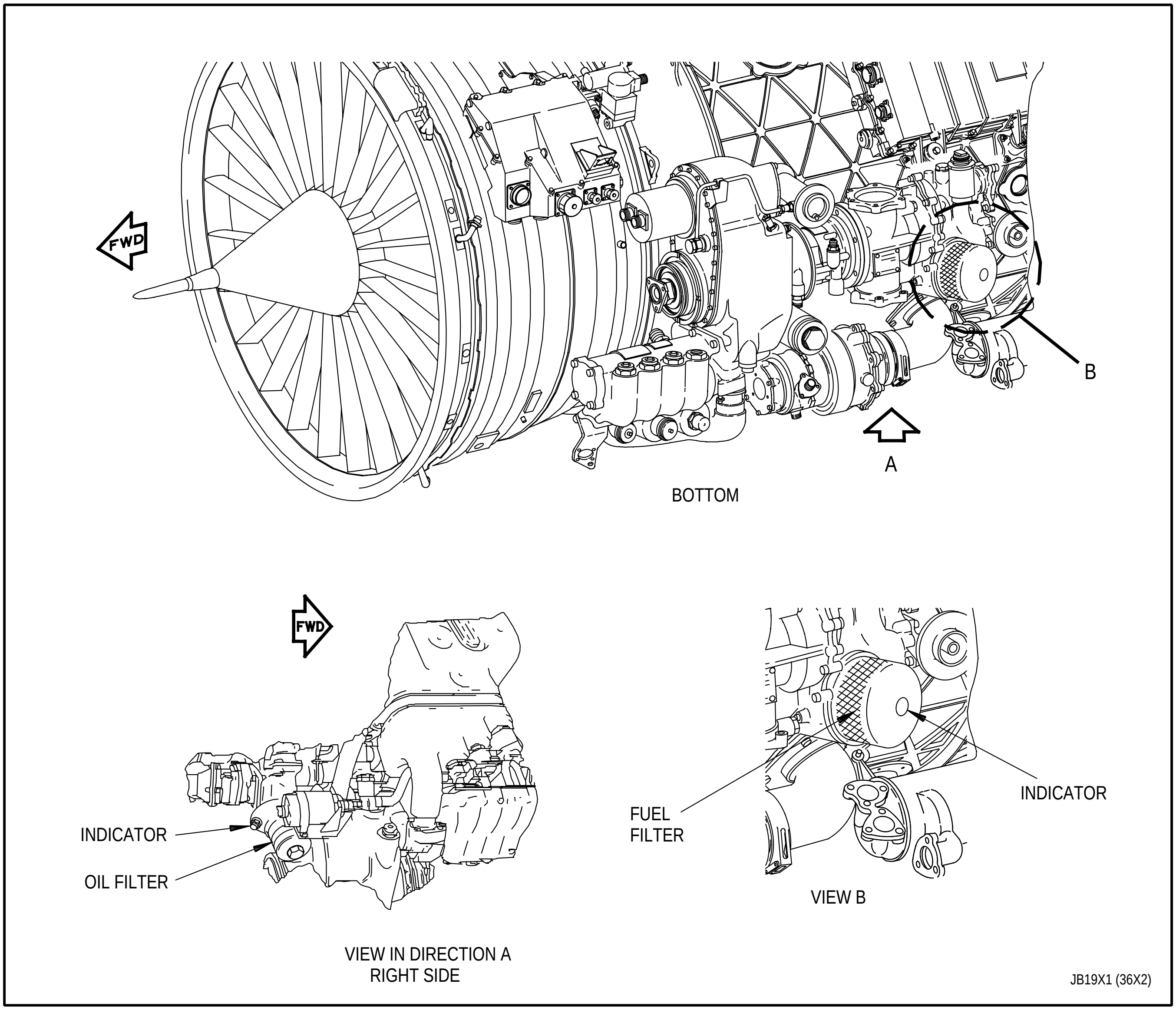


Figure 6. Malfunction Indicator - Locations

NOTE

Perform step e. if test oil filter was installed, otherwise proceed to step f.

e. Remove oil filter (test oil filter if previously installed) and install clean engine oil filter as follows: (See figure 7 and 8.)

WARNING

Oil filter bowl is full of oil. Use appropriate care when removing filter bowl. Shutoff valves in filter head will prevent further draining of oil system.

NOTE

If ΔP indicator on filter head is extended, filter element is contaminated and shall be replaced.

(1) Unscrew oil filter bowl from filter head. Pour lubricating oil in bowl into plastic container.

(2) Remove oil filter element from bowl. Discard packings.

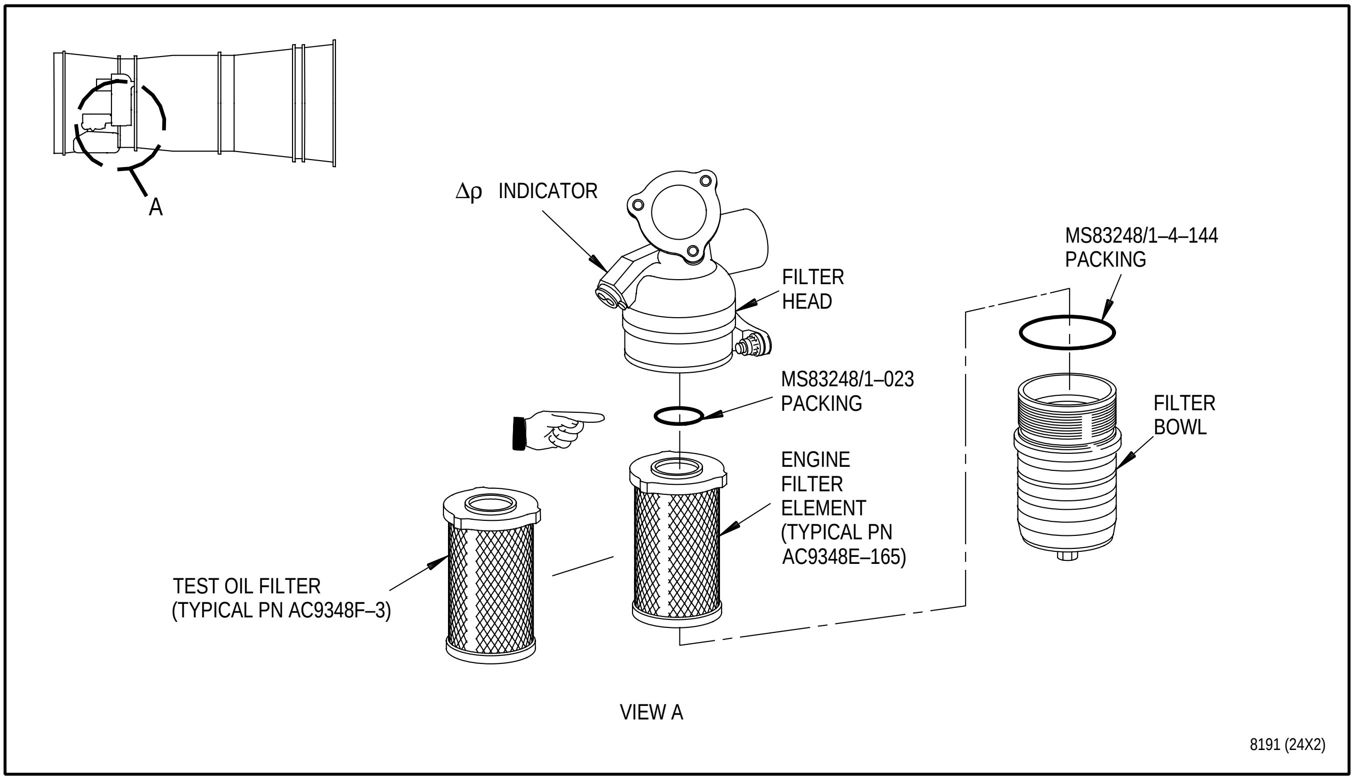


Figure 7. Oil Filter Element - Installation

CAUTION

Use only MIL-L-7808 oil or VV-P-236 petrolatum to lubricate preformed packing.

(3) Lubricate packings (M83248/1-023 and M83248/1-144) and threads of filter bowl with a light coat of MIL-L-7808 oil or VV-P-236 petrolatum.

(4) Install PN M83248/1-023 packing on top of filter element. Install PN MS83248/1-144 packing on filter bowl. Place element in filter bowl.

CAUTION

Do not exceed 300 pound-inches of torque in obtaining proper clearance between filter head and filter bowl.

(5) Install filter bowl and element on head. Tighten filter bowl until clearance between mating shoulders of filter head and bowl is 0.000 to 0.030 inch.

(6) Lockwire filter bowl with PN MS9226-04 wire.

(7) Reset oil filter differential pressure by pushing in red button.

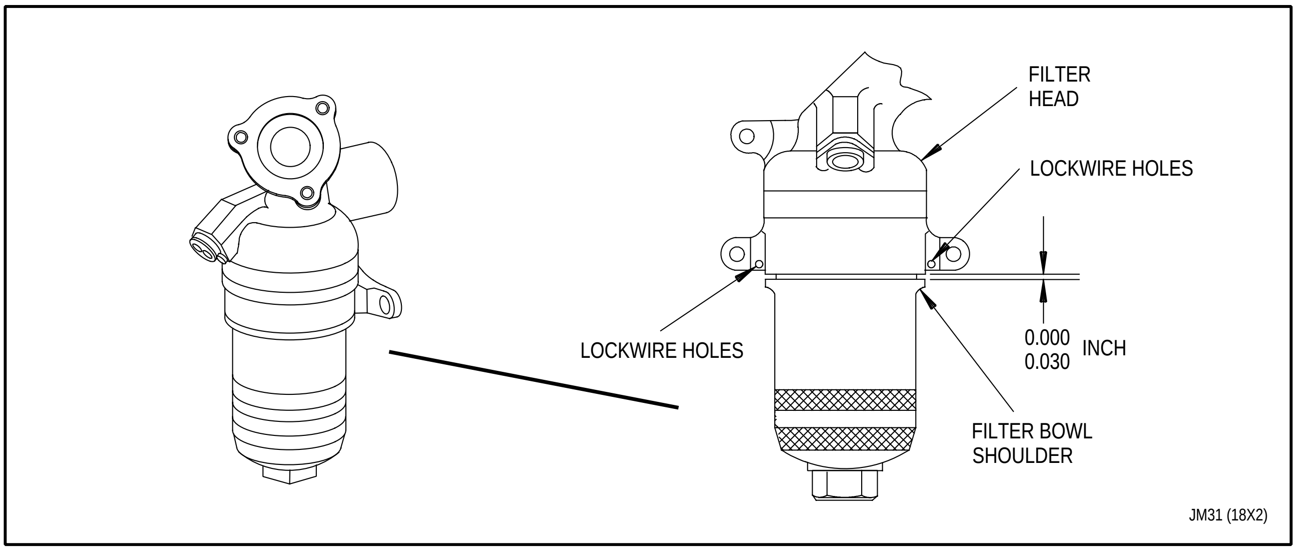


Figure 8. Main Oil Filter Bowl and Filter Head - Clearance

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE LEAK CHECK AND GASPATH INSPECTION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	2				
5 Deleted	2				
6 Blank Deleted	2				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Start Procedures	WP 210 00
Engine Shutdown	WP 225 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection - Equipment and Operation	WP 021 00
Turbojet, Turbofan and Ground Power and Airbourne Support Turbine Engines: General Engine and Test Cell Instructions	T.O. 2J-J1-10

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
Compound, antigalling (PWA 550)	Hi-T-650 or Lubri-Bond HT
Lockwire (0.032 inch diameter)	MS9226-04
Oil, lubricating	MIL-L-7808 or
Petrolatum (alternate to oil)	VV-P-236

EXPENDABLE ITEMS

Nomenclature	Part Number	Quantity
Packing, preformed	ST1051-08	

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION

a. This work package contains instructions for preparing an engine leak check and gaspath inspection.

2. ENGINE PREPARATION FOR LEAK CHECK.

a. Remove Pmb main breather pressure adapter and secure engine tube connection as follows:

(1) Remove Pmb test hose from diagnostic tee.

(2) Apply PWA 550 antigalling compound or equivalent to threads of diagnostic cap. Remove excess.

(3) Install diagnostic cap on diagnostic tee.

(4) Torque diagnostic cap 90 to 100 pound-inches. Lockwire using PN MS9226-04 wire.

b. Remove MOT/Popd probe as follows:

(1) Remove hose and cable from probe.

(2) Loosen locknut on probe, then remove probe.

(3) Lubricate PN MS9902-08 plug threads with PWA 550 antigalling compound or equivalent. Remove excess.

CAUTION

Use only MIL-L-7808 oil or VV-P-236 petrolatum to lubricate preformed packing.

(4) Lubricate PN ST1051-08 packing with MIL-L-7808 oil or VV-P-236 petrolatum.

(5) Install plug and packing in tube manifold. Torque plug 210 to 230 pound-inches. Lockwire using PN MS9226-04 wire.

c. Remove P119 ignition CUT-OUT cable.

d. Secure all loose test hoses removed from test tooling to prevent possible interference during engine leak check.

3. ENGINE LEAK CHECK AND GASPATH INSPECTION.

a. Prepare engine for leak check test per paragraph 2.

b. Start engine per WP 210 00.

c. Allow engine to stabilize at IDLE.

d. Visually perform leak check of all engine components, and locations from which test tooling was removed.

e. If any leaks are found in excess of limits defined in WP 205 00, shut down engine per WP 225 00 and repair leaks. Restart engine and inspect.

NOTE

Do not shut down test cell or engine if engine is to be preserved.

f. Shut down engine per WP 225 00.

g. Shut down test cell per T.O. 2J-J1-10.

h. Inspect inlet and exhaust areas for evidence of damage; loose or missing parts, or any abnormal conditions. Record all observed discrepancies. Inspect synchronizing ring and adjacent parts and replace as necessary.

i. Regardless of prior engine maintenance, perform a complete internal borescope inspection per T.O. 2J-F100-53-5, WP 021 00 following engine test. Record all discrepancies.

WORK PACKAGE

TECHNICAL PROCEDURES

JOINT OIL ANALYSIS PROGRAM (JOAP) WEARMETAL GUIDELINES

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 11	0				
12 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test -	T.O. 2J-F100-11-2
Oil System Contamination -	WP 304 00
On Condition Maintenance Manual -	T.O. 2J-F100-53-2
Joint Oil Analysis Program (JOAP) Laboratory Manual - - -	T.O. 33-1-37

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains instructions and guidelines for JOAP sample laboratory analysis results.

2. JOINT OIL ANALYSIS PROGRAM (JOAP) WEARMETAL GUIDELINES.
(See Tables 1 and 2.)

NOTE

These are guidelines to be used with T.O. 33-1-37, Joint Oil Analysis Program (JOAP), which apply unless specifically excepted.

a. Following instructions shall apply when evaluating analysis results:

(1) Any sample results, which JOAP lab analysis indicates requirement to place engine on surveillance or perform teardown inspection, shall be confirmed by second sample. If any oil has been added to system, check with JOAP lab on advisability of additional run since a second sample shall be taken after performing a 5 to 15 minute engine run at idle.

(2) Further engine operation is not permitted, unless results of second sample are acceptable.

NOTE

JOAP lab analysis and chip detector inspection shall be closely monitored to detect impending engine component failure.

b. All engines which have been torn down for inspection due to exceeded JOAP limits shall be placed on surveillance for a minimum of 10 operating hours.

Table 1. JOAP Sampling Rate And Maintenance Action - Engine Not In Surveillance

Condition	Sampling Requirements	Maintenance Action
NOTE Take sample prior to servicing oil system.		
Ground operation analysis not indicating surveillance	Take a sample at time interval not exceeding three engine operating hours. Also take sample after last run of day.	a. Continued operation permissible for two hours operating time before analysis results are available. b. For atomic absorption method, four hours operating time permissible before Ti analysis results are available. c. Engine shall not be released for flight prior to satisfactory analysis results.
NOTE If oil has been added to system, take sample after 5 to 15 minute engine run at IDLE.		
Increase of two ppm or more (atomic absorption method) or four ppm or more (emission method) in Fe between current sample and any other sample within last 10 engine operating hours.	Take second sample.	Inspect chip detectors for metal particles and main oil filter ΔP indicator for extension with each sample. Place engine on surveillance if second sample confirms contamination trend of first sample.

Table 1. JOAP Sampling Rate And Maintenance Action - Engine Not In Surveillance (continued)

Condition	Sampling Requirements	Maintenance Action
NOTE If oil has been added to system, take sample after 5 to 15 minute engine run at IDLE.		
Increase of four ppm or more (atomic absorption method) or five ppm or more (emission method) of Fe between any two consecutive samples.	Take second sample.	Inspect chip detectors for any metal particles and main oil filter ΔP indicator for extension with each sample. If second sample confirms trend of first sample, perform teardown inspection to determine cause of wearmetal reading.
NOTE If oil has been added to system take sample after 5 to 15 minute engine run at IDLE.		
Al wearmetal reaches -T- code value.	Take second sample.	Inspect chip detectors for any metal particles and main oil filter ΔP indicator for extension with each sample. If second sample confirms trend of first sample, remove gearbox module for teardown inspection.
NOTE If oil has been added to system take sample after 5 to 15 minute engine run at IDLE.		
Any wearmetal except Al reaches -T- code value.	Take second sample.	Inspect chip detectors for any metal particles and main oil filter ΔP indicator for extension with each sample. If second sample confirms trend of first sample, perform teardown inspection on engine.

Table 2. JOAP Sampling Rate And Maintenance Action - Engine In Surveillance

Condition	Sampling Requirements	Maintenance Action
NOTE Take sample prior to servicing oil system.		
Test stand operation during surveillance	Take sample at intervals not to exceed one hour operating time and after last engine run of day. Perform chip detector inspection with each sample.	a. Continued operation is permissible for one hour maximum until JOAP analysis results shall be known. b. For atomic absorption method only, it is permissible to continue operation for two hours before Ti analysis results shall be known.
NOTE Take sample after 5 to 15 minute engine run at IDLE.		
Increase of two ppm or more (atomic absorption method) or four ppm or more (emission method) in Fe between current sample and any other sample within last 10 engine operating hours.	Take second sample.	Inspect chip detectors for any metal particles and main oil filter ΔP indicator for extension with each sample. If second sample confirms trend of first sample, perform teardown inspection to determine cause of wearmetal reading.
NOTE Take sample after 5 to 15 minute engine run at IDLE.		
Al wearmetal reaches -T-code value.	Take second sample.	Inspect chip detectors for any metal particles and main oil filter ΔP indicator for extension with each sample. If second sample confirms trend of first sample, remove gearbox module for teardown inspection.

Table 2. JOAP Sampling Rate And Maintenance Action - Engine In Surveillance (continued)

Condition	Sampling Requirements	Maintenance Action
NOTE Take sample after 5 to 15 minute engine run at IDLE.		
Any wearmetal except al reaches -T- code value.	Take second sample.	Inspect chip detectors for any metal particles and main oil filter ΔP indicator for extension with each sample. If second sample confirms trend of first sample, perform teardown inspection on engine.
Readings after 10 hours in surveillance fail to confirm teardown requirement.		Check chip detectors. Remove engine from surveillance if chip detectors are free of particles. If particles are present, disassemble engine to areas indicated by contaminated chip detectors to locate particles. Check main source of oil filter ΔP indicator for extension.

c. During any ground operation when engine is not in surveillance, the following requirements apply:

(1) Joint Oil Analysis Program (JOAP) samples shall be taken at intervals not to exceed three engine operating hours. Additionally, sample shall be taken after last run of day.

(2) Continued ground operation is permissible only for next two hours of engine operating time before analysis results are available.

(3) For atomic absorption equipment only, it is permissible to continue ground operation for next four hour time period before titanium analysis results are available.

(4) Samples shall be taken prior to oil system servicing.

(5) Engine shall not be released for flight operation prior to satisfactory analysis results.

(6) In addition to values specified in T.O. 33-1-37, all of the following criteria shall be applied to detect trends in iron (Fe) content.

(a) For atomic absorption:

1 An increase of two ppm or more in Fe between current sample and any other sample, within last 10 engine operating hours, shall place engine in surveillance. Chip detector inspection is required at this time.

2 If Fe increases four ppm between any two consecutive samples, engine shall undergo teardown inspection to determine cause of wearmetal reading. Refer to T.O. 2J-F100-53-2 for teardown sequence.

(b) For emission spectrometer:

1 An increase of four ppm or more in Fe between current sample and any other sample within last ten engine operating hours, shall place engine in surveillance. Chip detector inspection is required at this time.

2 If Fe increases five ppm between any two consecutive samples, engine shall undergo teardown inspection to determine cause of wearmetal reading. Refer to T.O. 2J-F100-53-2 for teardown sequence.

WARNING

Engine oil may be hot. Exercise care when removing chip detectors for inspection or maintenance.

NOTE

- Remove and install chip detectors one at a time. Carefully inspect detectors from all angles in a well-lighted area.
- Do not touch inner end of detector to avoid disturbing metal particles before visual inspection is completed.
- If available, use edge of paper towel to draw oil from detector gap for better inspection.

(7) Inspect chip detectors for metal particles and main oil filter ΔP indicator for extension with each sample.

d. During any ground operation when engine is in surveillance, the following requirements hold:

(1) When engine is in surveillance on the test stand, JOAP sampling is required as follows:

(a) Before starting engine, if maintenance for JOAP has been performed or if oil has been added

(b) After 5 to 15 minutes at IDLE; then

(c) At intervals not exceeding one hour of engine operation.

(d) Continued engine operation is permitted for one hour maximum after sampling until JOAP analysis results are known. Per atomic absorption method only, it is permissible to continue operation for two hours before titanium (Ti) analysis results shall be known.

(2) When engine is on test stand, chip detector inspection is required concurrent with each JOAP sample.

(3) Samples shall be taken prior to oil system servicing.

(4) In addition to values specified in T.O. 33-1-37, all of following criteria shall be applied to detect trends in Fe contents.

(a) For atomic absorption: An increase of two ppm or more in Fe between current sample and any other sample, within last 10 engine operating hours, shall require engine teardown inspection to determine cause of wearmetal reading. Refer to T.O. 2J-F100-53-2 for teardown sequence.

(b) For emission spectrometer: An increase of four ppm or more in Fe between current sample and any other sample within last ten engine operating hours, shall require engine teardown inspection to determine cause of wearmetal reading. Refer to T.O. 2J-F100-53-2 for teardown sequence.

NOTE

- Remove and install chip detectors one at a time. Carefully inspect detectors from all angles in a well-lighted area.
- Do not touch inner end of detector to avoid disturbing metal particles before visual inspection is completed.
- If available use edge of paper towel to draw oil from detector gap for better inspection.

(5) Inspect chip detectors for metal particles and main fuel filter ΔP indicator for extension with each sample taken.

e. If aluminum wearmetal reaches -T-code value specified in T.O. 33-1-37, gearbox module shall be removed for teardown inspection. Refer to T.O. 2J-F100-53-2 for aluminum sources.

NOTE

If engine is rejected for excessive titanium wearmetal in oil, piston ring seal grooves in No. 2 bearing front, No. 3 bearing rear carbon seal ring holder assemblies, and No. 3 bearing support shall be inspected for wear.

f. If any other wearmetal reaches -T- code value specified in T.O. 33-1-37, engine shall undergo teardown inspection to determine cause of wearmetal reading. Refer to T.O. 2J-F100-53-2 teardown sequence.

g. If an engine on surveillance does not confirm teardown criteria within 10 operating hours, engine may be removed from surveillance. Chip detectors shall be checked at this time. Refer to WP 304 00. Remove engine from surveillance if chip detectors are free of particles. If particles are present, disassemble engine to area indicated by contaminated chip detector or to locate source of particles. Refer to T.O. 2J-F100-53-2.

NOTE

- Mandatory inspection of the No. 4 bearing is required only for an iron (Fe) increase of nine ppm or greater in 10-hour period; however, the No. 4 bearing should be suspect for wearmetal for all levels of iron (Fe) increase above the current four ppm/10-hour JOAP manual limit.
- No. 4 bearing inspection is not mandatory if it can be verified that Fe is coming from an engine component other than No. 4 bearing. Chip detector and partial engine teardown inspections can be used as criteria for verification.

h. For an increase in Fe of nine ppm or greater between the current sample and any other sample within the last ten hours, an inspection of No. 4 bearing is required.

i. If contamination levels of oil samples are excessive, reject engine and forward for teardown inspection. Refer to T.O. 2J-F100-53-2.

WORK PACKAGE

TECHNICAL PROCEDURES

OIL SYSTEM CONTAMINATION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 18

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1 - 2	24				
3 - 17	0				
18	24				
19 - 22 Deleted	24				

REFERENCE MATERIAL REQUIRED

Title	Number
Standard Maintenance Procedures	T.O. 2-1-111
Engine Test	T.O. 2J-F100-11-2
Engine Oil System Servicing	WP 109 00
Engine Start Procedures	WP 210 00
Engine Shutdown	WP 225 00
Oil System Flushing	WP 308 00
On-Condition Maintenance Manual	T.O. 2J-F100-53-2
Chip Detector Particles/JOAP Test Failure	WP 030 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Main Gear Fuel Pump	WP 005 00
Fuel/Oil Cooler	WP 028 00
Oil Filter	WP 030 00
Tank Assembly - Lubricating Oil	WP 031 00
Fan Drive Turbine Module	T.O. 2J-F100-53-9
Support Assembly, No. 5 Bearing, Inner - Disassembly	WP 025 00
Support Assembly, No. 5 Bearing, Inner - Assembly	WP 606 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
Bag, plastic (18″ x 12″)	-
Cloth, clean, dry, lint-free	-
Fine filter paper	-
Oil, lubricating	MIL-L-7808

EXPENDABLE ITEMS

Nomenclature	Part Number	Quantity
Packing, preformed	M83248/1-023	1
Packing, preformed	M83248/1-144	1
Packing, preformed	NAS-1593-012	As required

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains criteria and guidance to troubleshooting oil system contamination, including chip detectors, oil filter, fuel in oil, and nonmetallic contamination.

2. CHIP DETECTORS - INSPECTION.

(See Figures 1 and 2.)

a. Remove, inspect, and install chip detectors as follows: (See figures 1 and 2.)

NOTE

- Remove and inspect chip detectors one at a time for metal particles.
- Before inspection, inner end of magnetic chip detector shall not be handled to avoid inadvertant removal of any metal particles. Do not disturb particles if they are present. To improve visual inspection, edge of paper towel may be used to carefully draw oil out of detector gap. Inspection should be performed in well-lighted area, from sides as well as head on.

(1) Push in on knurled knob (or scalloped grip) of chip detector and rotate one-quarter turn counterclockwise; remove chip detector from housing.

NOTE

If upon analysis, foreign particles are found to be other than metal, refer to paragraph 6.

(2) Inspect all chip detectors for metal particles. If particles were found, refer to paragraph 4.

(3) Inspect packings for damage, replace if necessary.

(4) Lubricate two PN NAS-1593-012 packings and stem of chip detector with light coat of MIL-L-7808 engine oil or equivalent. Install packing in grooves of chip detectors.

CAUTION

Ensure chip detector is installed in positive locked position. An improperly installed detector may result in bearing damage and subsequent engine failure

(5) Install metal chip detector in check valves of main gearbox or pump, as follows:

(a) Align three lugs of chip detector with three slots in check valve.

(b) Depress chip detector into check valve and turn clockwise. Release and verify that detector is locked in position.

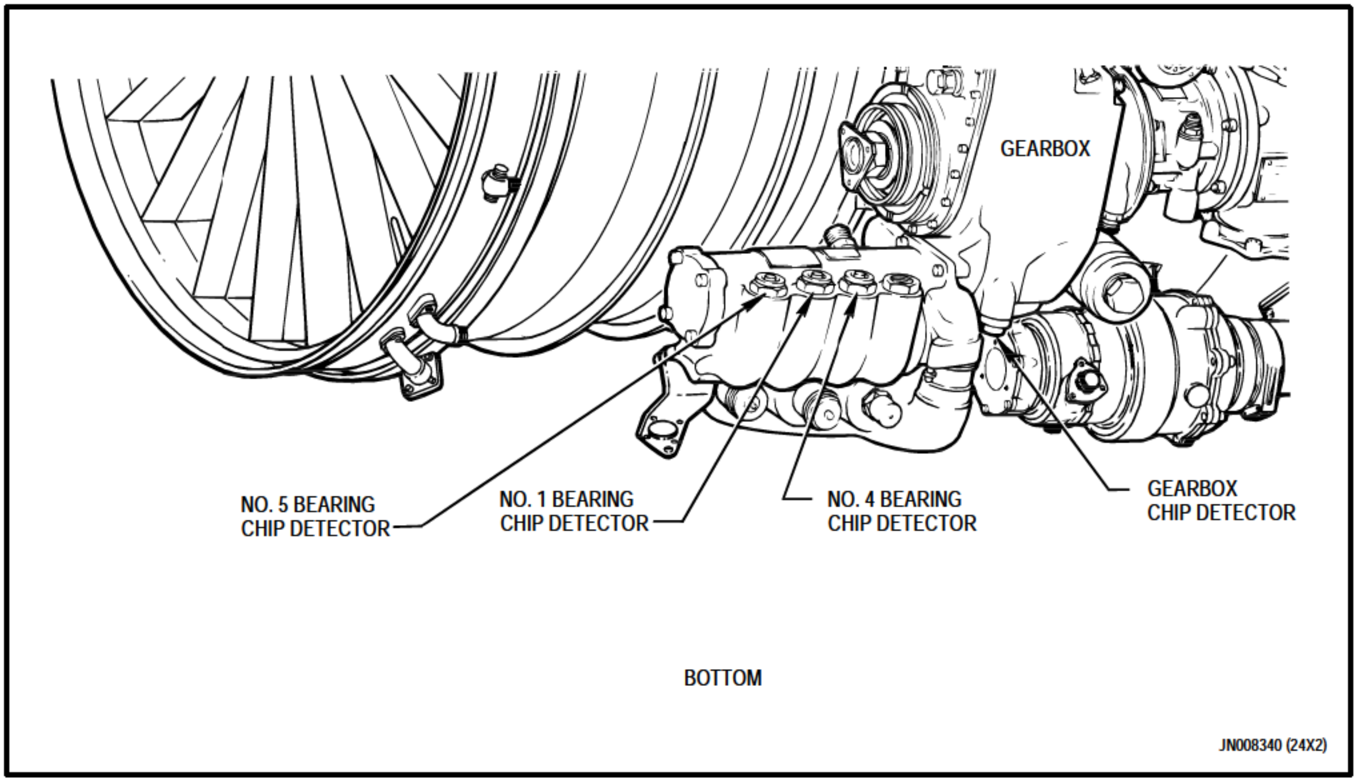


Figure 1. Chip Detector - Locations

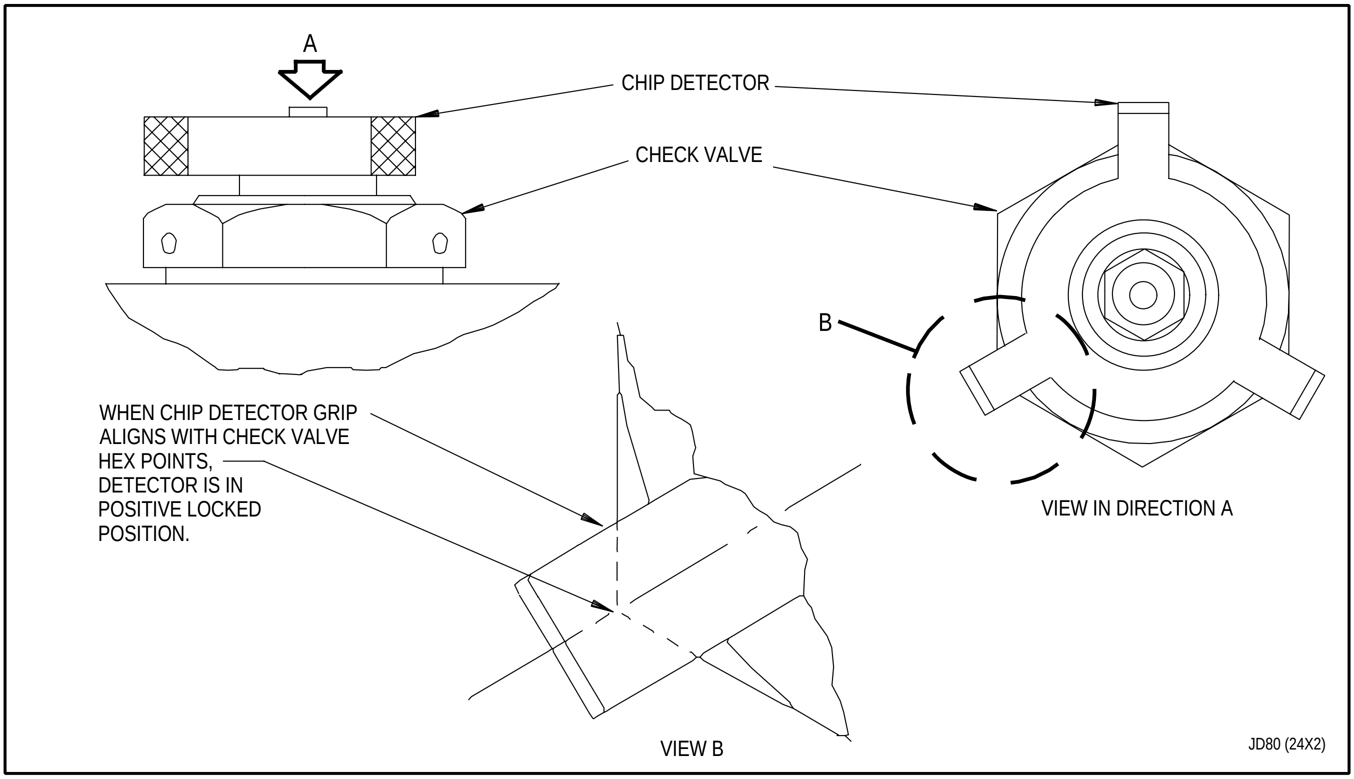


Figure 2. Chip Detector - Installation/Alignment

3. OIL FILTER - INSPECTION.

(See Figure 3.)

a. Check oil filter ΔP indicator (red button) for extension. Excessive pressure drop across filter element due to clogging will extend indicator. For corrective action refer to paragraph 5.

WARNING

Oil filter bowl is full of oil. Use appropriate care when removing filter bowl. Shutoff valves in filter head will prevent further draining of oil system.

NOTE

If ΔP indicator (red button) is extended, filter is contaminated and requires replacement.

b. Unscrew filter bowl from filter head. Pour oil from bowl through a clean cloth to retain particles for inspection. Refer to T.O. 2J-F100-53-4, WP 030 00.

c. To prevent particle loss, lift filter element from bowl over a clean cloth.

d. Discard packings from top of element and filter bowl.

e. Inspect particles per paragraph 5.

f. Install bowl and new or clean filter element as follows: (See T.O. 7J2-27-3 for element cleaning.)

(1) Lubricate PN M83248/1-023 and PN M83248/1-44 packings and threads of filter bowl with a light coat of MIL-L-7808 oil or equivalent.

(2) Install PN M83248/1-023 packing on top of filter element and PN M83248/1-144 on filter bowl. Place element in filter.

(3) Install filter bowl and element on head. Tighten filter bowl until clearance between mating shoulders of filter head and bowl is 0.000 to 0.030 inch. Do not exceed 300 pound-inches torque to obtain proper clearance between filter head and filter bowl. (See figure 3.)

(4) Lockwire filter bowl with PN MS9226-04, lockwire.

(5) Reset oil filter ΔP indicator (red button) on filter head by pushing in red button.

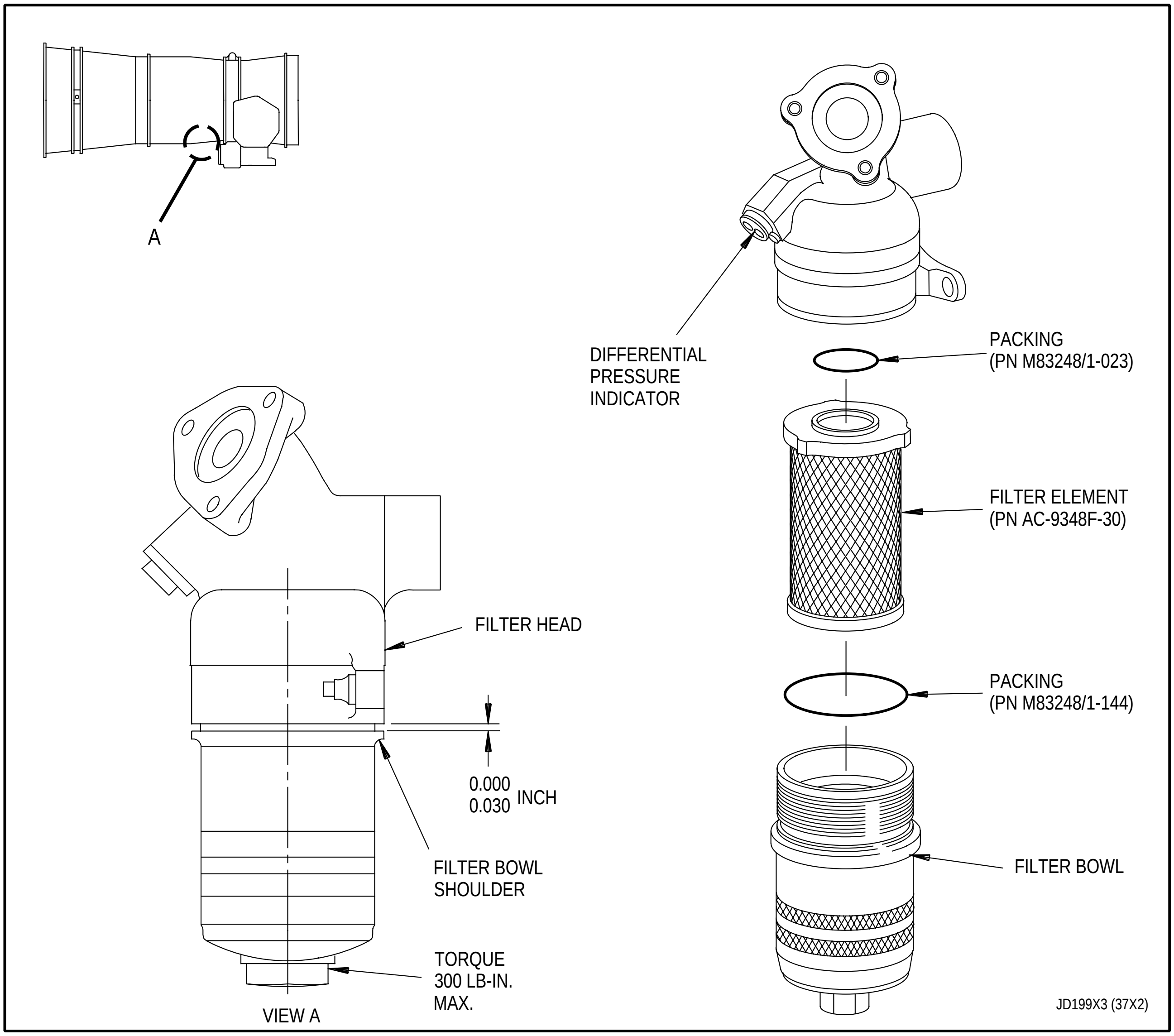


Figure 3. Filter Element - Replacement

4. CHIP DETECTOR CONTAMINATION - INSPECTION CRITERIA.

(See Figures 4 and 5.)

NOTE

- This paragraph contains inspection criteria to troubleshoot engines that have metal particles on chip detectors.
- This should not be applied to engines which have been rejected for teardown due to exceeding organizational level inspection criteria while installed in an aircraft.
- When engine teardown is required due to exceeding chip detector inspection criteria, refer to T.O. 2J-F100-53-2, WP 030 00.

a. Document on engine historical records any time particles are found in oil filter element or maintenance is performed for particles found on a chip detector as follows: (Fan, Core, LPT, or Gearbox) module maintenance for chip detector No. (or oil filter particles), date and engine TOT.

b. Chip detector contamination is categorized as LEVEL 1, 2, 3, 4, or LARGE PARTICLE according to the following definitions (see figures 4 and 5).

(1) LEVEL 1 - One, two or three metal particle(s), less than 1/16 inch in diameter and 1/32 inch in thickness, without numerous small particles around the center magnet.

(2) LEVEL 2 - Metal particle(s) not longer than 1/2 the reference gap, with numerous small particles around the center magnet.

(3) LEVEL 3 - Metal particle(s) as long or longer than 1/2 the reference gap, with numerous small particles around the center magnet.

(4) LEVEL 4 - Metal particle(s) as long or longer than the reference gap with additional particles extending the equivalent of 25% or more around the center magnet.

(5) LARGE PARTICLE - Metal particle over 1/16 inch in diameter and 1/32 inch in thickness (Example: gear tooth tip).

c. Perform corrective action when chip detector contamination is discovered in engine shop or test stand as follows:

(1) If LEVEL 1 contamination is found, clean and reinstall chip detector per paragraph 2. No further action required.

(2) If LEVEL 2 contamination is found perform a documentation check to determine if engine experienced LEVEL 2 or 3 contamination in last 10 engine flight hours (EFH) before coming to shop or test stand.

(a) If two LEVEL 2 or LEVEL 3 finding(s) occurred within last 10 EFH, disassemble engine to determine source of particles. Refer to T.O. 2J-F100-53-2, WP 030 00.

(b) If only one LEVEL 2 or no findings occurred within last 10 EFH, proceed to step c.(4).

(3) If LEVEL 3 contamination is found perform a documentation check to determine if engine experienced LEVEL 2 or 3 contamination in last 10 engine flight hours (EFH) before coming to shop or test stand.

(a) If a LEVEL 2 or LEVEL 3 finding(s) occurred within the last 10 (EFH), disassemble engine to determine source of particles. Refer to T.O. 2J-F100-53-2, WP 030 00.

(b) If no findings occurred within last 10 EFH, proceed to step c.(4).

(4) Perform contamination criteria guidance as follows:

(a) If engine is on JOAP surveillance, disassemble engine to determine source of particles. Refer to T.O. 2J-F100-53-2, WP 030 00.

(b) If engine is not on surveillance, take JOAP sample and inspect oil filter for contamination per paragraph 3.

(c) If oil filter inspection indicates requirement for disassembly (refer to paragraph 5), disassemble engine to determine source of particles. Refer to T.O. 2J-F100-53-2, WP 030 00.

(d) If JOAP sample analysis indicates requirement to place engine on surveillance, disassemble engine to determine source of particles. Refer to T.O. 2J-F100-53-2, WP 030 00.

(e) If JOAP surveillance is not required and filter inspection does not indicate requirement to disassemble engine, perform contamination check run per paragraph c.(6).

(5) If LEVEL 4 or large particle contamination is found, disassemble engine to determine source of contamination. Refer to T.O. 2J-F100-53-2, WP 030 00.

(6) Perform contamination check run as follows:

(a) Ensure oil filter and all chip detectors are clean and properly installed.

(b) Perform oil servicing if required per WP 109 00.

(c) Inspect chip detectors per paragraph 2.

1 If LEVEL 1, 2, 3 metal particles are found, proceed to step (6)(d).

2 If no particles are found, proceed to step (6)(h).

3 If LEVEL 4 or LARGE PARTICLE(S) contamination is found, disassemble engine to determine source of particles. Refer to T.O. 2J-F100-53-2, WP 030 00.

(d) Clean and reinstall chip detectors per paragraph 2.

(e) Remove, inspect and reinstall oil filter element per paragraph 3.

(f) Drain and reservice oil system. Refer to WP 109 00.

(g) Repeat steps (c) through (f) as required.

(h) Perform a 2 hour engine run, varying power from Idle to Intermediate (MIL). Refer to WP 210 00 and 225 00.

(i) Inspect chip detectors per paragraph 2.

1 If LEVEL 2 or greater contamination is found, disassemble engine to determine source of particles. Refer to T.O. 2J-F100-53-2, WP 030 00.

2 If LEVEL 1 or no contamination is found, clean as required and reinstall chip detectors per paragraph 2.

(j) Inspect oil filter element per paragraph 3.

1 If inspection does not indicate requirement for disassembly (refer to paragraph 5) and no LEVEL 2 or higher contamination is found on chip detectors, return engine to service.

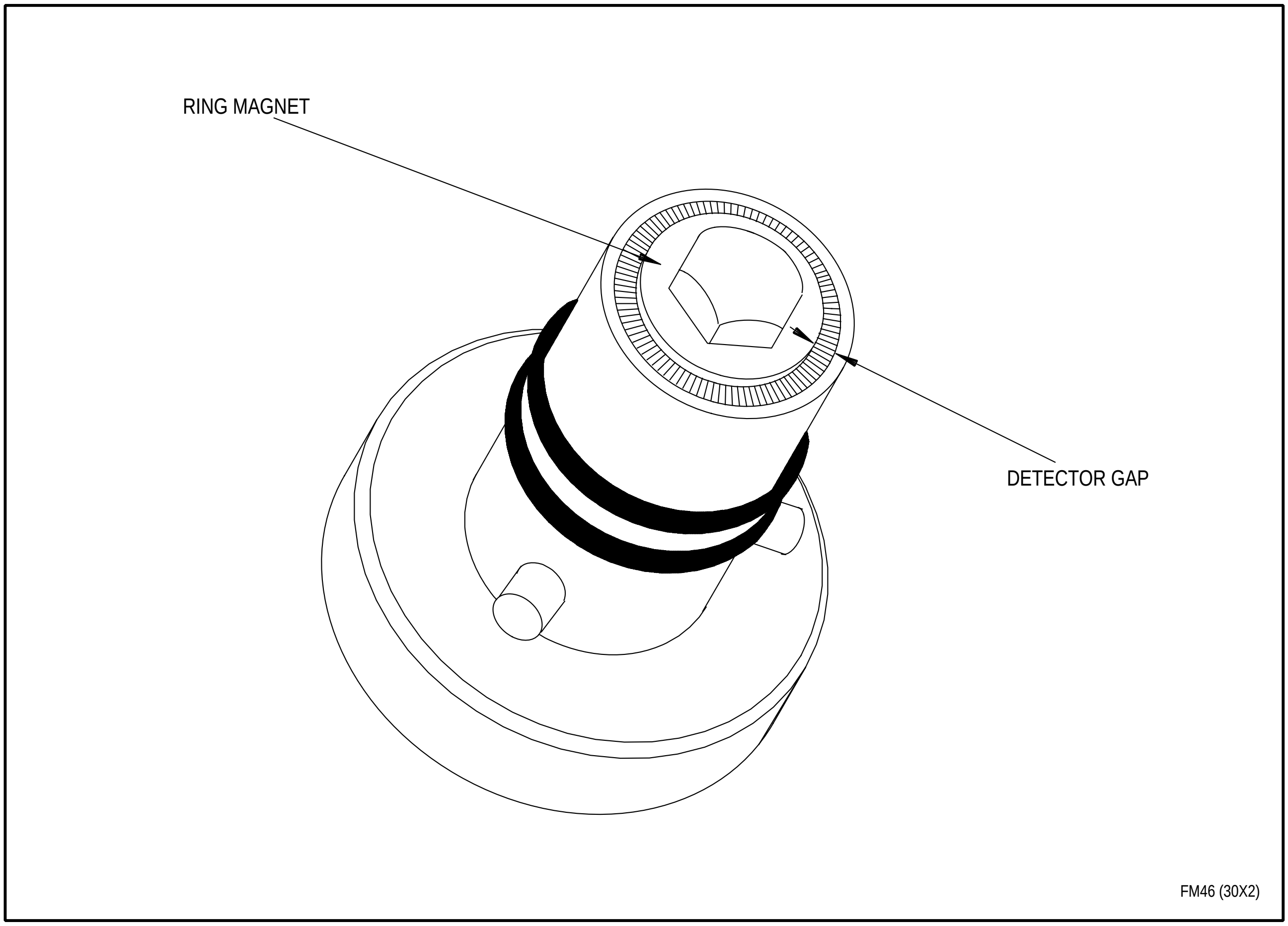


Figure 4. Chip Detector (Typical)

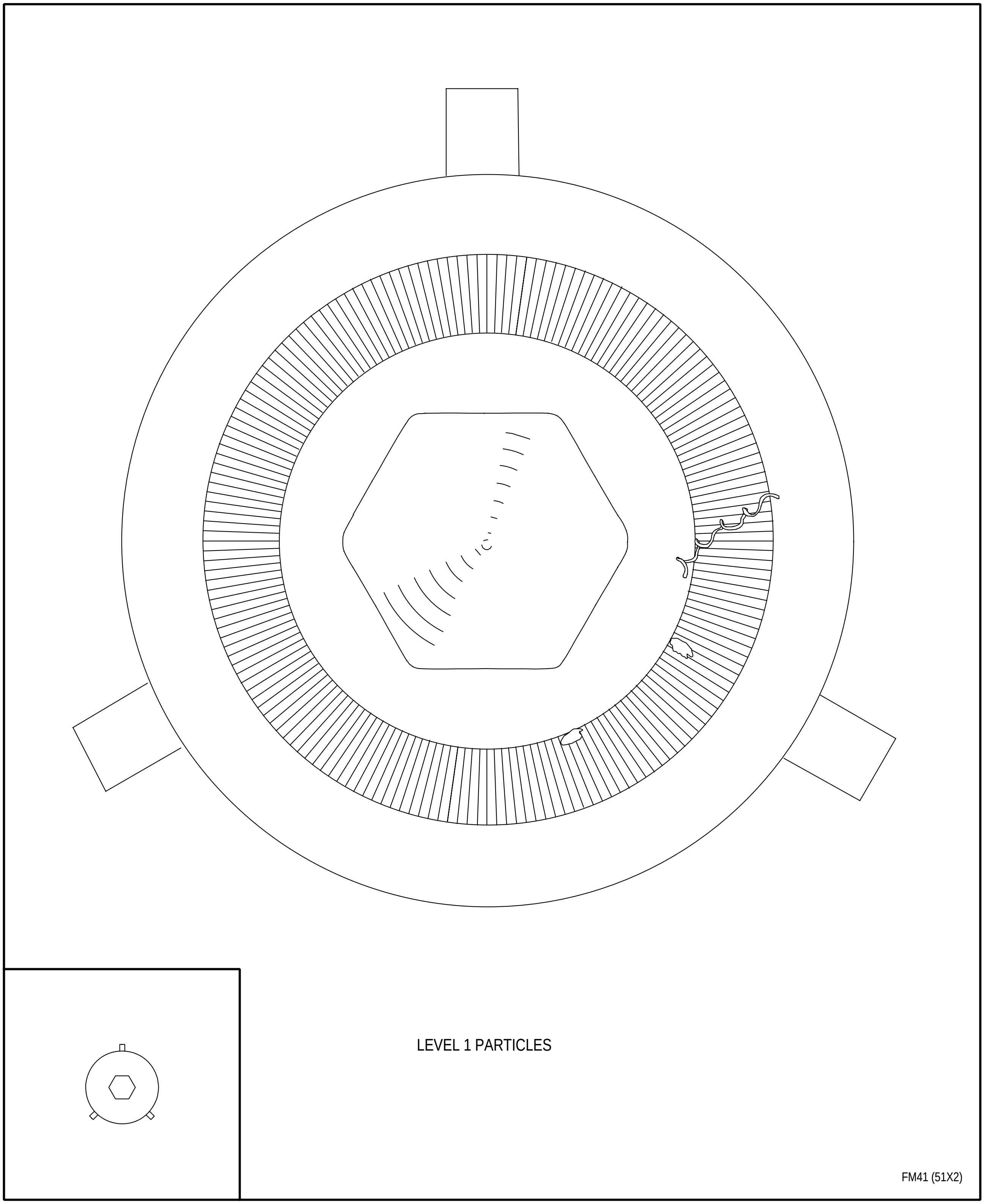


Figure 5. Chip Detector - Contamination (Sheet 1 of 5)

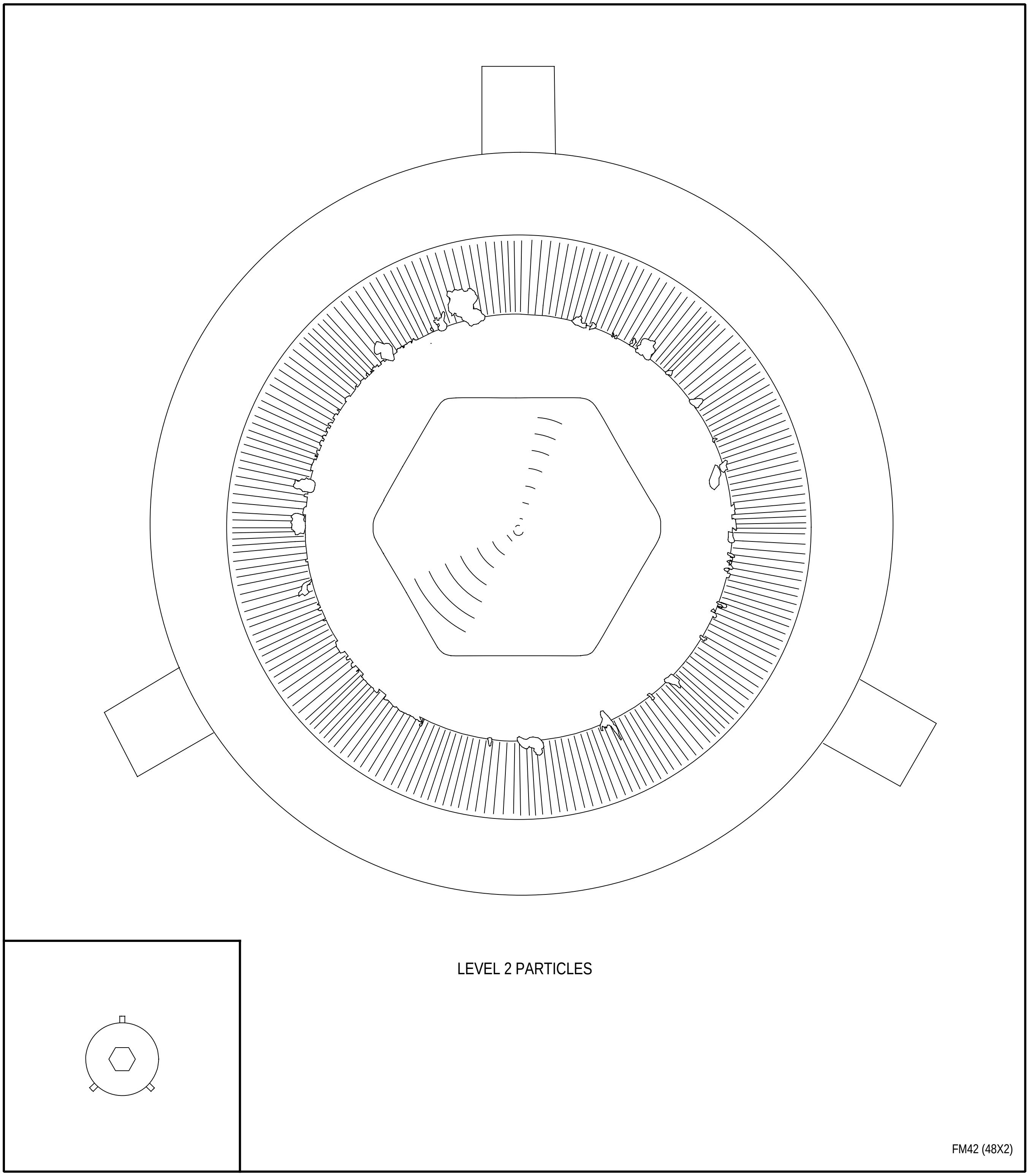


Figure 5. Chip Detector - Contamination (Sheet 2 of 5)

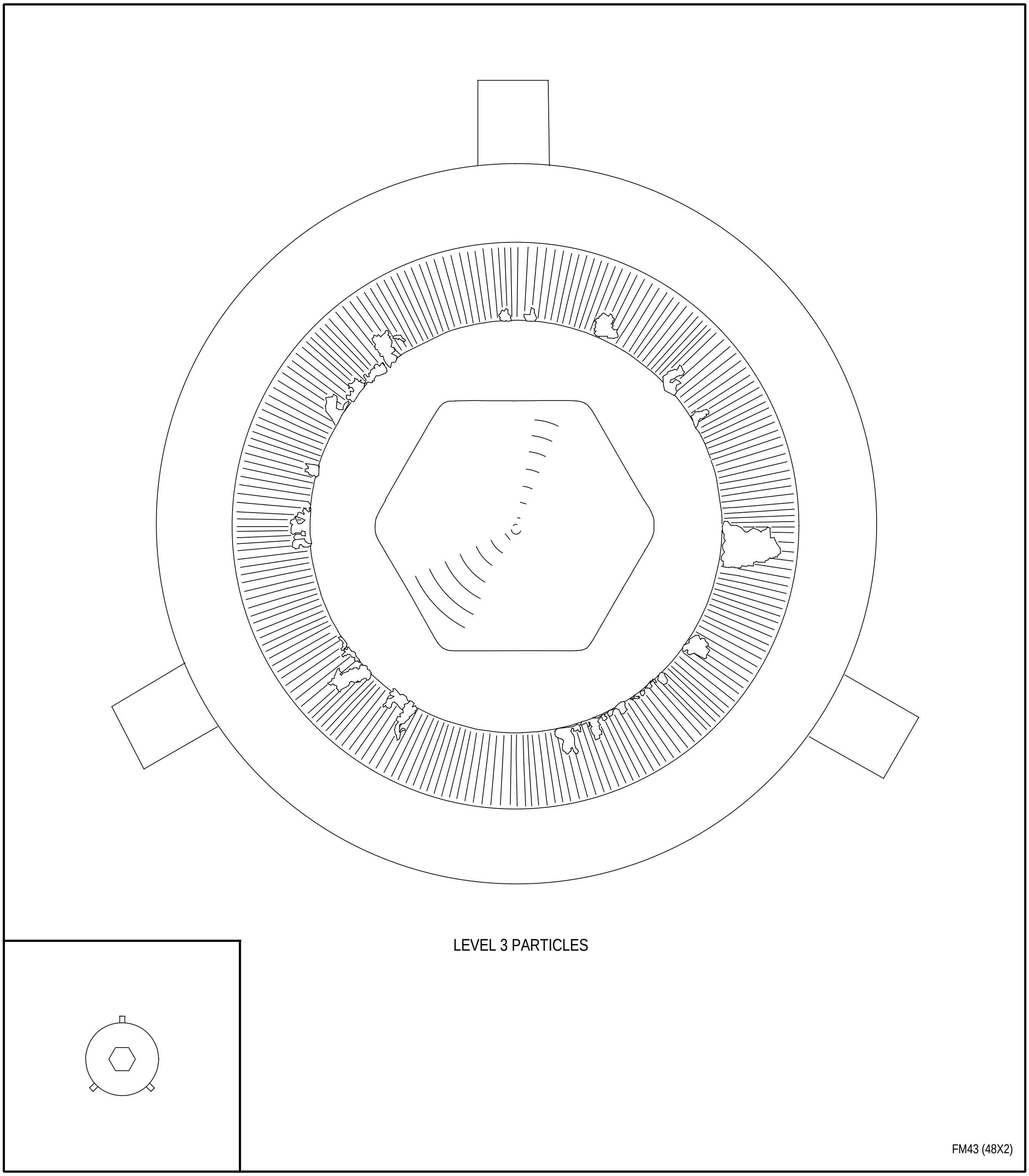


Figure 5. Chip Detector - Contamination (Sheet 3 of 5)

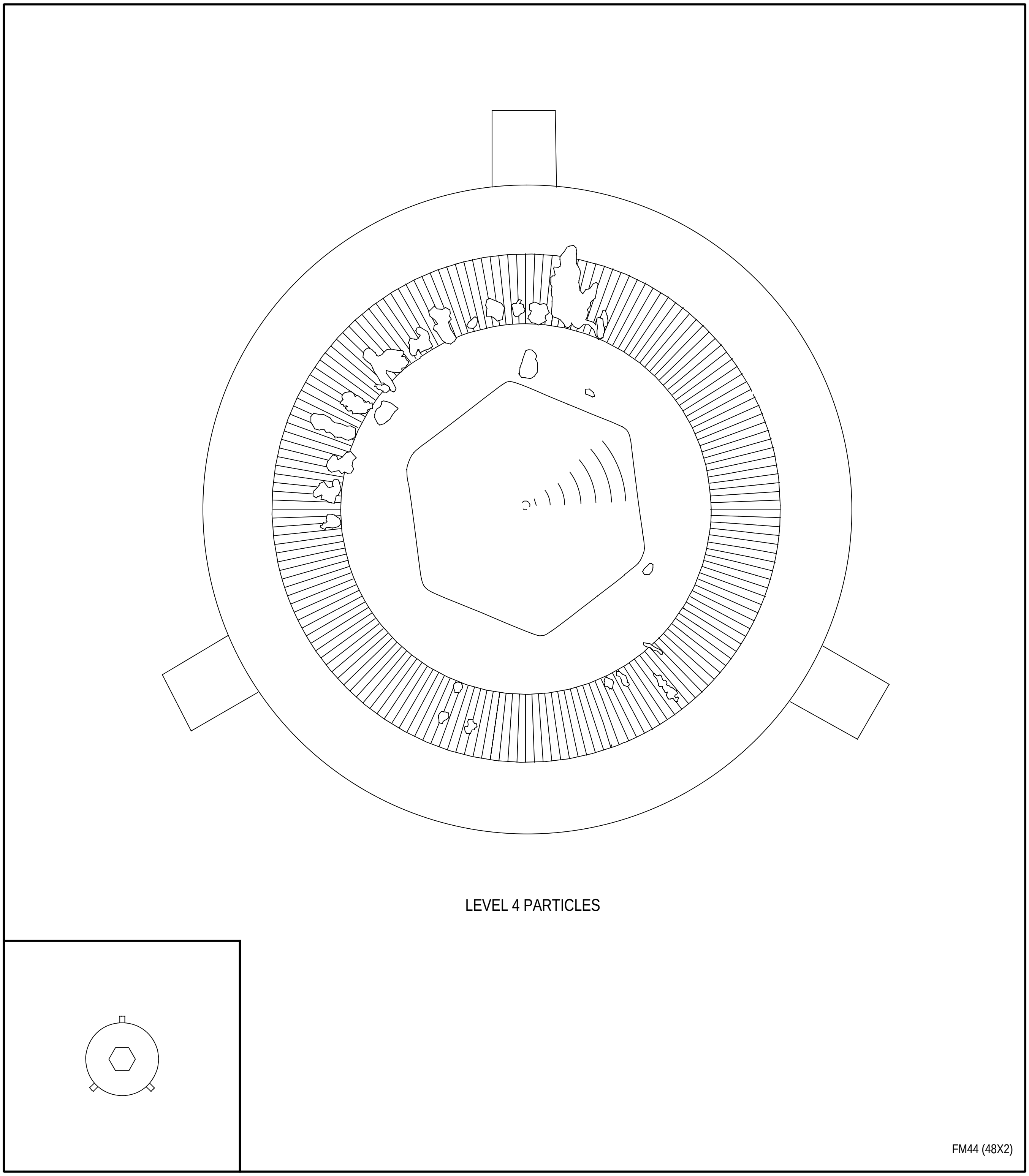


Figure 5. Chip Detector - Contamination (Sheet 4 of 5)

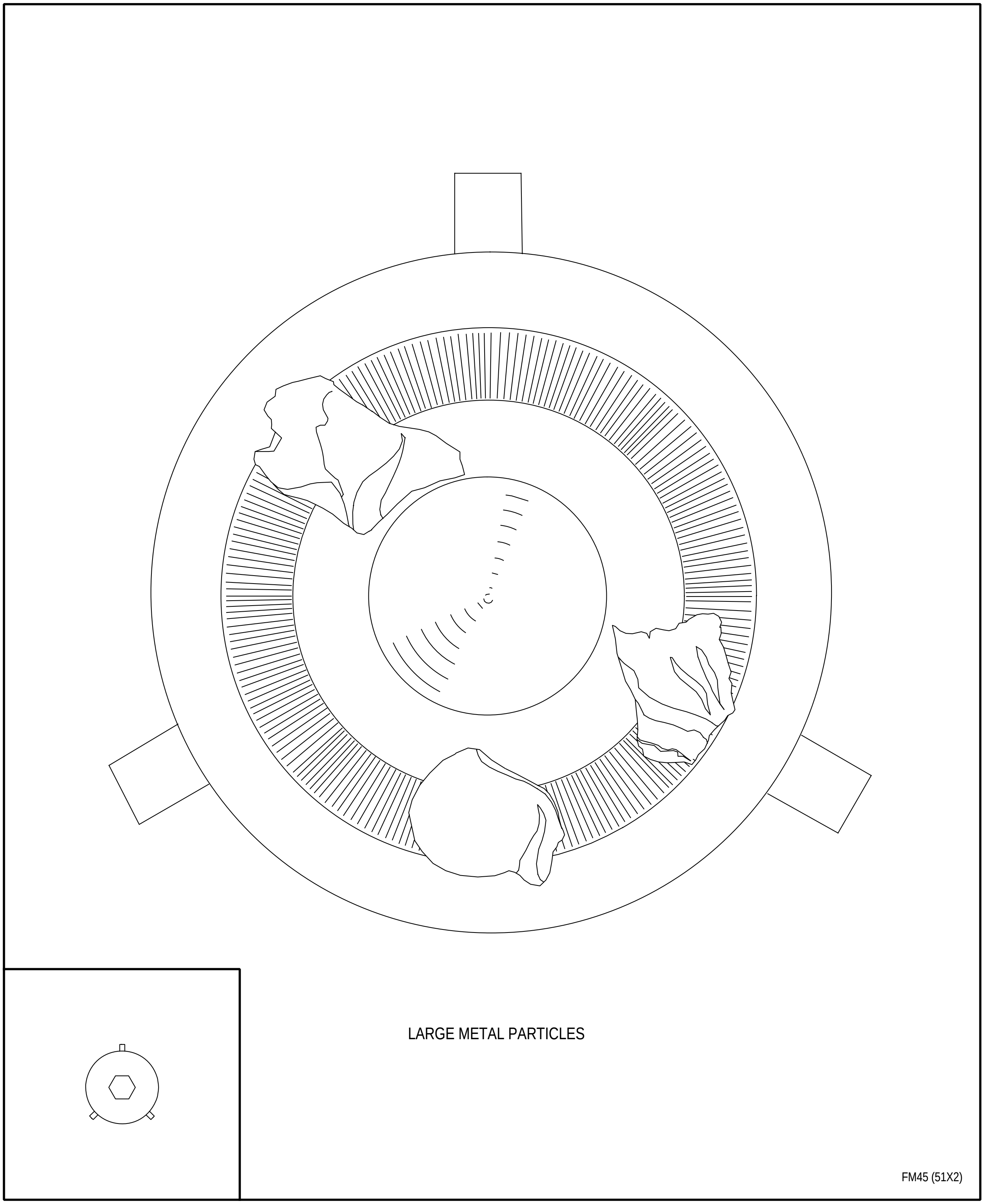


Figure 5. Chip Detector - Contamination (Sheet 5 of 5)

5. OIL FILTER CONTAMINATION - INSPECTION CRITERIA.

a. Any time particles are found in oil filter element or maintenance is performed for particles found on chip detector, document Engine Historical Record as follows: (Fan, Core, LPT, or Gearbox) module maintenance for chip detector No. _____(or oil filter particles), date and engine TOT.

b. If ΔP indicator (red button) on filter head is extended, and filter element is found to be contaminated, engine disassembly is required to determine source of contamination.

c. If ΔP indicator is extended, but filter element is not contaminated, replace ΔP indicator. Refer to T.O. 2J-F100-53-4, WP 030 00.

d. During oil filter inspection, if a large particle of metal is found (refer to paragraph 4.c.(5)), engine disassembly is required to determine source of contamination.

6. GENERAL NONMETALLIC CONTAMINATION.

a. If during oil filter inspection or general maintenance engine lubrication system is found to be contaminated with nonmetallic particles (Example: carbon, dirt, sludge or rubber), drain oil. Refer to WP 109 00.

b. Remove oil tank, fuel oil cooler, and affected lines. Refer to T.O. 2J-F100-53-4, WP 028 00 and 031 00.

c. Clean system.

d. Check oil system for possible seal extrusion when bits of rubber are found in oil.

e. Install new oil seals where seals were disturbed.

f. Reinstall oil system components.

7. FUEL CONTAMINATION IN THE OIL.

a. This paragraph contains guidelines for suspected fuel contamination in oil system.

b. Any time oil contamination with fuel is suspected, the engine oil system will be drained and flushed per WP 308 00. The source of contamination may be a result of internal fuel-to-oil leakage in fuel-to-oil cooler or failed main fuel pump driveshaft seal.

c. Oil contamination with fuel may be detected by an oil tank level increase, a prolonged flash of the JOAP sample when analyzed, or fuel odor in the oil.

d. Check main fuel pump seal drain for indications of excessive fuel leakage at drain ports, during engine IDLE.

(1) If a stream is evident, main fuel pump should be replaced. Refer to T.O. 2J-F100-53-4, WP 005 00.

(2) Inspect gearbox fuel pump driveshaft seal before installation of new main fuel pump; replace if necessary.

e. If no leakage is evident, fuel oil cooler is faulty and should be replaced. Refer to T.O. 2J-F100-53-4, WP 028 00.

f. Drain and flush engine oil system per WP 308 00.

All data on pages 19 and 20 deleted.

Figure 6. Deleted.

Figure 7. Deleted.

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE FUEL SYSTEM CONTAMINATION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 16

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 15	0				
16 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00
Emergency Procedures	WP 209 00
Engine Leak Check and Gaspath Inspection	WP 302 00
Main Fuel Pump Fuel Pressure Analysis	WP 661 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Pump - Fuel, Main Gear	WP 005 00
Control - Engine, Digital Electronic	WP 007 00
Control - Fuel, Augmentor	WP 010 00
Valve - Fuel Pressurizing and Dump	WP 011 00
Pump - Fuel, Augmentor	WP 013 00
Cooler - Fuel/Oil	WP 028 00
Engine	T.O. 2J-F100-53-5
Chamber, Combustion; Nozzles, Fuel; Vanes, Turbine Stator, First and Second Stages - Fibrescope/Borescope Inspection	WP 026 00
Core Engine Module	T.O. 2J-F100-53-7
Nozzle, Fuel - Removal	WP 011 00
Nozzle, Fuel - Installation	WP 706 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
Cloth, dry, lint-free	-
Fine filter paper	-
Solvent, petroleum	P-D-680, Type II

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

CAUTION

Fuel system contamination can cause engine system malfunctions, possibly resulting in operational problems and hot section distress. When test cell contamination is suspected, inspect engine processed through test cell.

a. This work package contains instructions for determining and correcting fuel system contamination.

2. CONDITIONS REQUIRING INSPECTION FOR ENGINE FUEL SYSTEM CONTAMINATION.

a. Inspection for engine fuel system contamination and resultant component maintenance actions must be performed following any one of the following occurences:

(1) Augmentor fuel control inlet wash filter is clogged.

(2) Main fuel control inlet wash filter is clogged.

(3) Main fuel pump filter is contaminated.

(4) Main fuel pump filter indicator is extended.

(5) Contamination is found in engine fuel system during maintenance or troubleshooting.

(6) Test cell fuel system is contaminated.

(7) Main fuel pump boost impeller or gear stage has failed.

(8) Augmentor fuel pump impeller has failed.

(9) Pressurizing and dump valve leaks.

b. Perform fuel system contamination inspection (paragraph 3), if any of the above occur.

3. ENGINE FUEL SYSTEM INSPECTION FOR CONTAMINATION.

(See Figures 1 through 3 and Tables 1 and 2.)

a. Inspect the main fuel pump filter as follows:

(1) Note position of fuel filter bypass indicator.

(2) Remove filter cover from main fuel pump. Refer to T.O. 2J-F100-53-4, WP 005 00.

(3) Strain fuel from filter cover through filter paper or clean cloth.

(4) Determine and take note of type of contaminant present and estimate percentage of filter element which is blocked.

(5) Inspect main fuel pump filter assembly per T.O. 2J-F100-53-4, WP 005 00.

(6) Clean filter cavity in pump housing and inside of filter cover with P-D-680, Type II petroleum solvent.

(7) Perform required maintenance on filter and downstream of filter based on filter element assessment in table 2.

Table 1. Types Of Contamination

Contaminant	Color	Appearance	Possible Sources
		Metallic	
Magnetic Steel	Dull or shiny silver	Chips, flakes, or granular	Fuel supply system Bearings in main fuel control, augmentor fuel control and main fuel pump Main fuel pump gears
Nonmagnetic-Aluminum	Dull or shiny silver	Chips, flakes, or granular	Fuel supply system MFP boost stage impeller Housings of main fuel control, augmentor fuel control, and main fuel pump
Bronze	Dull or shiny gold	Chips, flakes, or granular	Main fuel pump bearings Fuel supply system
		Nonmetallic	
Rubber	Various	Various	Fuel supply system Ingested caps
Plastic	Various	Various	Fuel supply system Ingested caps
Carbon	Black	Granular, chips	Fuel manifolds or tubes Fuel supply system
Fibrous	Various	Fuzzy	Fuel supply system Ingested rags
Fungus	Off-white	Gelatinous	Water contaminated fuel
Sand, dirt	Various	Granular	Fuel supply system

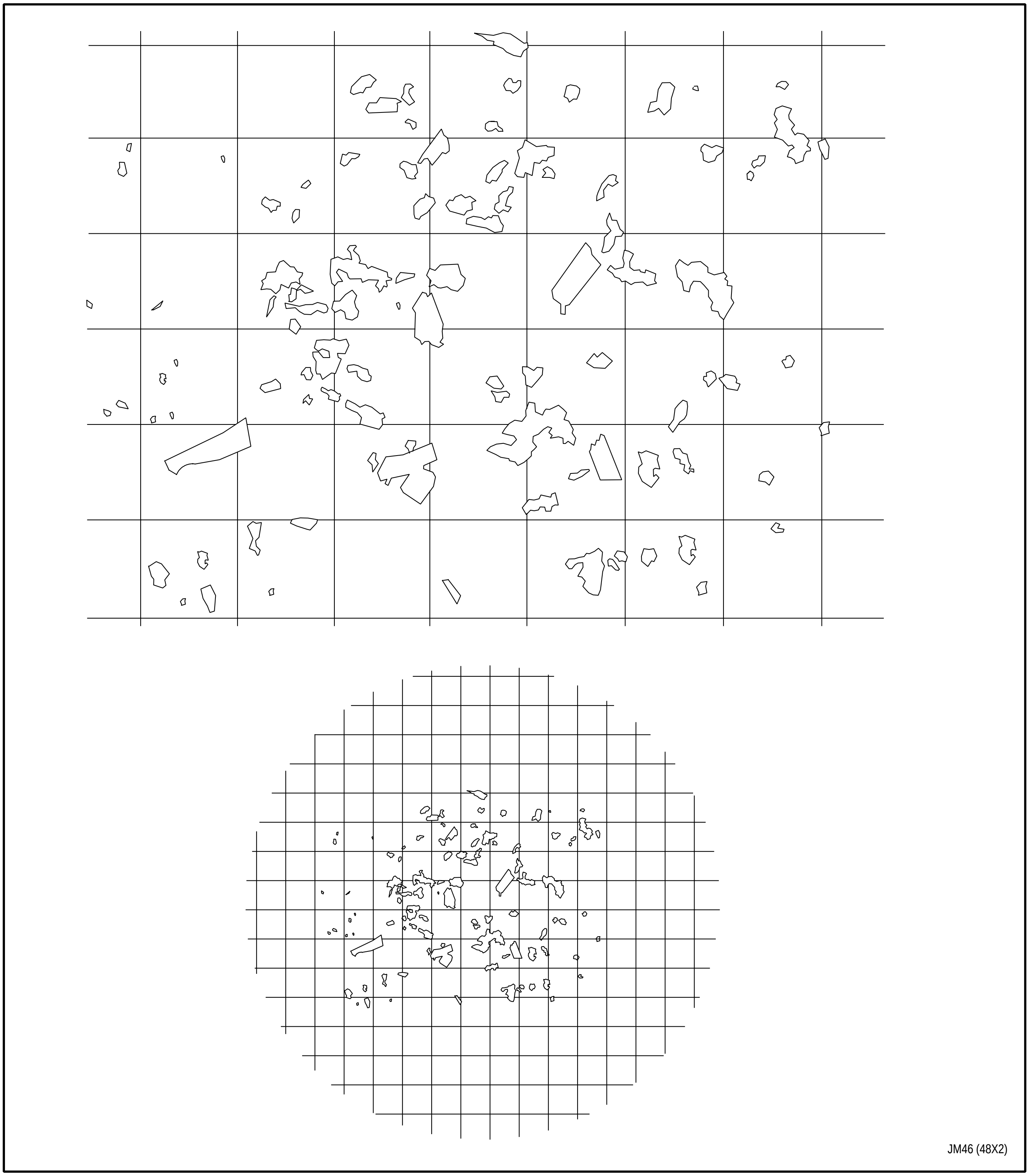


Figure 1. Contamination Consisting of Random Materials

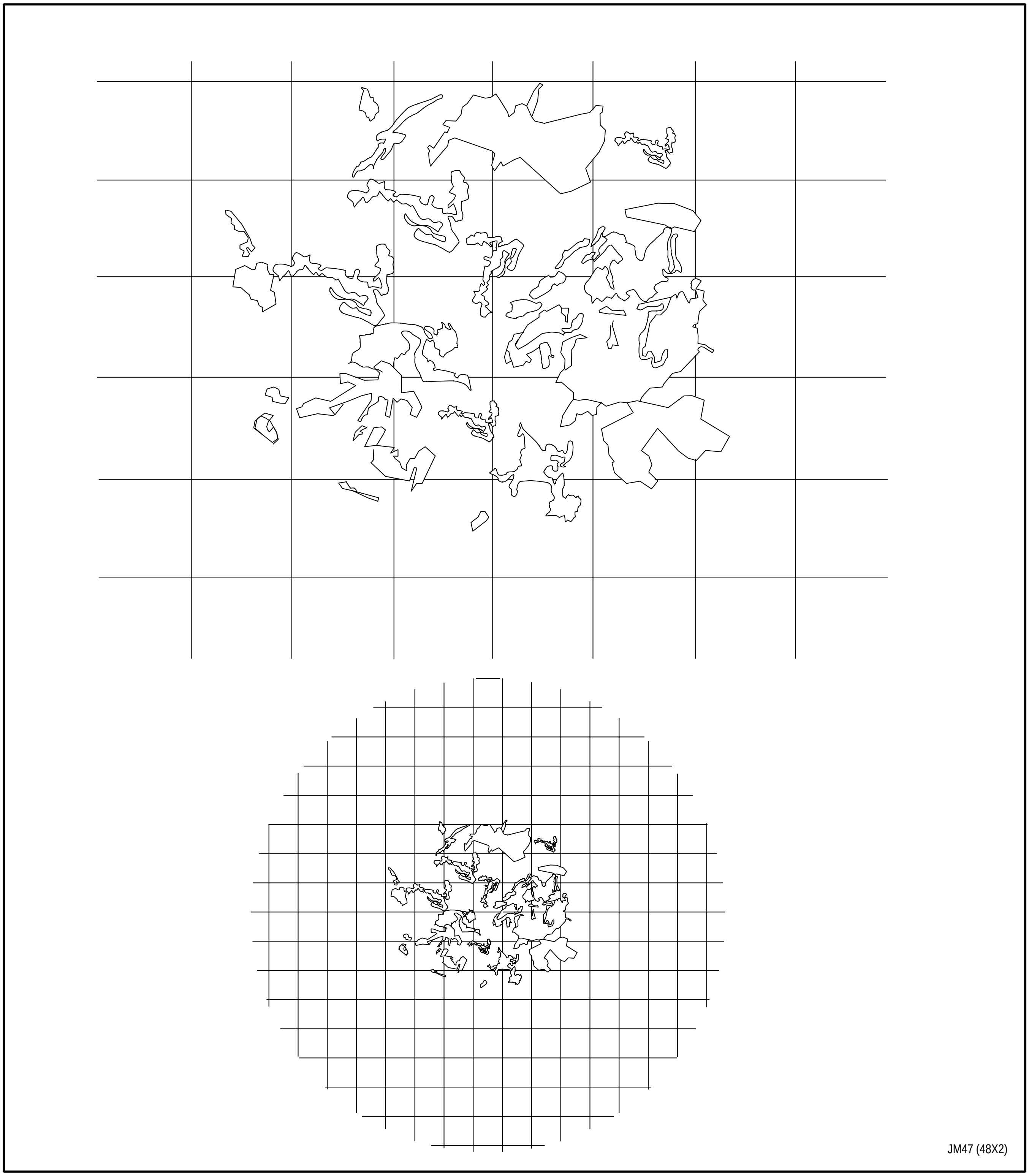


Figure 2. Contamination Consisting of Common Materials

Table 2. Main Fuel Pump Filter Inspection Procedure

Condition Found	Maintenance Required
NOTE If main fuel pump filter indicator button is extended, use table below to determine required maintenance actions.	
No Contamination	Install new packings in filter element and new packing in filter cover. Reinstall filter element. Perform engine leak check test and ensure indicator button does not re-extend. If indicator button extends, replace pump filter cover. If indicator button does not extend, return engine to service.
Metallic Contamination	Determine source of contamination. (See table 1.) Replace the following components. Replace main fuel control. Replace augmentor fuel control. Replace fuel/oil cooler. Replace main fuel pump. Replace pressurizing and dump valve. Flush all fuel lines between engine fuel filter and fuel nozzles. Replace all fuel nozzles. Borescope 1st and 2nd stage turbine vanes.

Table 2. Main Fuel Pump Filter Inspection Procedure (continued)

Condition Found	Maintenance Required
Nonmetallic Contamination	Determine source of contamination. (See table 1.) Determine extent of contamination by performing inspection procedures in figure 3. Replace components as required. Flush all fuel lines between pump fuel filter and fuel nozzles. Replace all fuel nozzles. Replace main fuel pump filter element.

NOTE

If main fuel pump filter indicator button is extended, use table below to determine required maintenance action.

Condition Found	Maintenance Required
No Contamination	Reinstall main fuel pump filter element. Return engine to service.
Metallic Contamination	If metallic contamination consists of small quantities (less than 100 pieces) of random material as in figure 1, replace main fuel pump filter element. If metallic contamination consists of: Large quantities of common materials as in figure 2, or Recognizable pieces of hardware (ie. bolts, washers, pins, springs, etc.), or Bronze chips, flakes or granules. Then: Determine source of contamination. (See table 1.) Determine extent of contamination of augmentor fuel supply system. (See figure 3.) Replace main fuel pump filter element.
Nonmetallic Contamination	Determine source of contamination. (See table 1.) Replace main fuel pump filter element.

b. Inspect all plumbing lines, component inlets and component outlets shown in figure 3 which are located downstream of contamination source. If contamination source is unknown, inspect all components in figure 3.

(1) Inspect plumbing lines as follows:

(a) Disconnect line to be inspected. Catch drained fuel in clean container and visually examine fuel for contaminants.

(b) If contaminants are present, strain fuel through clean cloth.

(c) Determine and take note of type, location, and approximate quantity of contaminants found.

(d) Clean tube by alternately flushing tube with cleaning solvent and blowing low pressure air through tube. No contaminant should be present when drained solvent is strained through a clean cloth.

(2) Inspect components as follows:

(a) Visually inspect component inlets and outlets.

(b) Carefully remove contaminants caught in inlet screens.

(c) Determine and take note of type, location, and approximate quantity of contaminants removed.

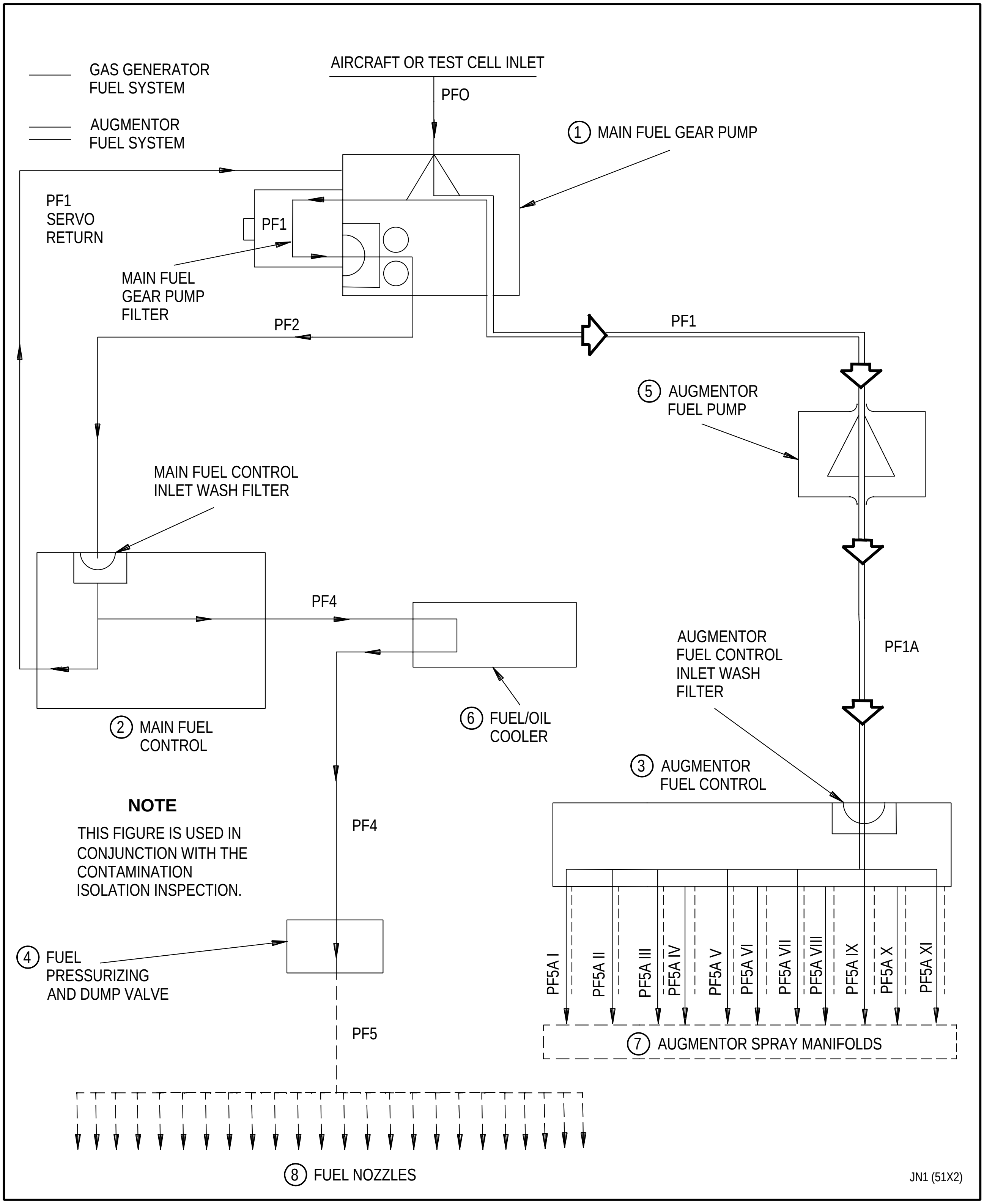


Figure 3. Fuel System Plumbing Lines and Component Inlets and Outlets

Legend for figure 3

	Component	Inspection Area	If Contamination Present, Maintenance Action Required
1.	Main Fuel Pump	Inlet (Pfo) Outlet (Pf1) Outlet (Pf2)	See paragraph 3.
2.	Main Fuel Control	GG inlet (Pf2/GG wash filter) GG outlet (Pf4)	If metallic contaminant found in Pf2 or Pf4 ports, replace main fuel control.
3.	Augmentor Fuel Control	Augmentor inlet (Pf1a/Augmentor wash filter) Augmentor outlet (Pf5a/Spray manifolds)	If metallic contaminant found in augmentor was filter, replace main fuel control, augmentor fuel pump, fuel/oil cooler, and augmentor spray manifolds.
4.	Fuel Pressurizing and Dump Valve	Outlet (Pf4)	If contamination is found, replace fuel pressurizing and dump valve.
5.	Augmentor Fuel Pump	Inlet (Pf1) Outlet (Pf1a)	If contamination is found, replace augmentor fuel pump.
6.	Fuel/oil cooler	Inlet (Pf4) Outlet (Pf4)	If contamination is found, replace fuel/oil cooler.
7.	Augmentor Spray Manifolds	Inlet (Pf5a 1-11)	If metallic contaminant found, replace augmentor spray manifolds and augmentor fuel control.
8.	Fuel Nozzles	Inlet (Pf5)	If contaminant is found, replace fuel nozzles.

4. MAINTENANCE ACTIONS REQUIRED ON COMPONENTS.
(See figures 1 and 2.)

NOTE

Components requiring replacement should be removed/ installed per T.O. 2J-F100-53-4 and T.O. 2J-F100-53-5.

a. Dispose of components based on contamination found during engine fuel system inspection as follows:

(1) When contamination consists of random materials with non-uniform sizes, which do not appear to originate from a common source, no component removal is required.

(2) When contamination contains a common material, with multiple pieces of similar size and appearance, which appear to have originated from a common source, component disposition is based on the following:

(a) If contamination consists of metallic material, san

- Augmentor fuel pump
- Augmentor spray manifolds
- Main fuel pump
- Main fuel control
- P&D valve
- Fuel/oil cooler
- Augmentor fuel control

(b) If contamination consists of paper, plastic or fibrous material and less than 30% blockage of main fuel pump filter and component inlet screens, clean fuel section of oil cooler by alternately flushing cleaning solvent and blowing low pressure air through main fuel control inlet and outlet ports. Repeat until no contamination is apparent when cleaning solvent is strained through a clean cloth.

(c) If contamination consists of paper, plastic or fibrous material and more than 30% of main fuel pump filter, or component inlet screens are blocked, replace the following:

- Main fuel control
- Fuel/oil cooler

(d) If contamination consists of rubber material, flush the oil cooler per step a.(2)(b).

b. Inspect main fuel pump filter after shutdown from initial engine run, following compliance with above contamination procedures. This will ensure that fuel system has been thoroughly flushed and contamination source has been correctly identified and eliminated.

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE PRESERVING

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 42

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3 - 6	0	8 - 19	0	23 - 42	0

REFERENCE MATERIAL REQUIRED

Title	Number
Corrosion Control of Gas Turbine Engines	T.O. 2J-1-18
Engine Test	T.O. 2J-F100-11-2
Preliminary Engine Dress	WP 005 00
Engine Oil System Servicing	WP 109 00
Engine Motoring	WP 110 00
Engine Start Procedures	WP 210 00
Engine Acceptance Test	WP 212 00
Engine Shutdown	WP 225 00
Engine and AF8624150 Test Cell Adapter Removal From AF8624151 Thrust Frame	WP 307 00
Test Tooling Removal From Engine (Undress)	WP 401 00
Engine Transfer From AF8624150 Test Cell Adapter to Shipping Support on ALC 3000E Transportation Trailer	WP 402 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Valve Assembly - Breather Pressurizing	WP 027 00
Filter - Oil	WP 030 00
Tank Assembly - Lubricating Oil	WP 031 00
Depot Engine	T.O. 2J-F100-53-5
Engine Packing (Preparation for Storage and Shipment)	WP 004 00
Packing Engine in Polyethylene (Plastic) Shroud	WP 043 00
Packing Engine in Flexible, Reusable Engine Container	SWP 043 02
Cables and Hoses, Tube, and Manifold Assemblies - Engine External Installation, Routing, and Clamping	WP 064 00
Tank Assembly, Lubricating Oil - Removal	WP 110 00
Gearbox Module	T.O. 2J-F100-53-11
Gearbox Module - Removal of Externally Accessible Accessories and Parts	WP 011 00
Gearbox Pressure Check	WP 705 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
Compound, antigalling (PWA 550)	Hi-T-650 or Lubri-Bond HT
Container, plastic (five gallon capacity)	-

CONSUMABLE MATERIALS (continued)

Nomenclature	Specification/Vendor Part Number
Lockwire (0.032 inch diameter)	MS9226-04
Lockwire (0.040 inch diameter)	MS9226-05
Oil, lubricating	MIL-L-6081, Grade 1010
Oil, lubricating	MIL-L-7808 or
Petrolatum (alternate to oil)	VV-P-236

EXPENDABLE ITEMS

Nomenclature	Part Number	Quantity
Packing, preformed	MS9967-214	1
Packing, preformed	ST1000-019	1
Packing, preformed	ST1000-218	1
Packing, preformed	ST1000-219	1
Packing, preformed	ST1001-10	1
Packing, preformed	ST1050-016	3
Packing, Preformed	ST1051-10	4

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
5	Cold Engine Preserving	
	Coupling Assembly, Fuel supply	PN 103-3015SC-1
	Drain cap	PWA 51192
	Purolator filter	PN 50223
7	Nonrotating-engine Preserving	
	Hydraulic cart	PWA 50096
8	Rotating-engine Represerving	
	Tank and Pump Unit	PMU-29/E
	Adapter	PWA 51103

ILLUSTRATED SUPPORT EQUIPMENT

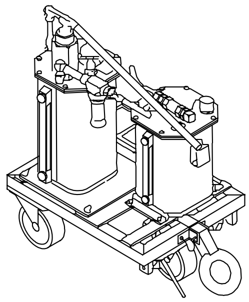


Figure T1. PMU-29/E Pump

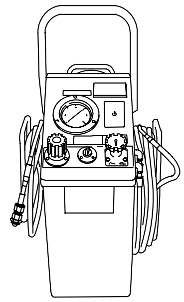


Figure T2. PWA 50096 Hydraulic Cart

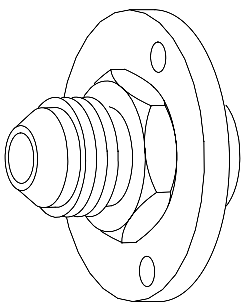


Figure T3. PWA 51103 Adapter

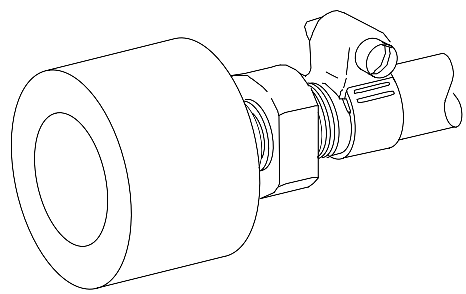


Figure T4. PWA 51192 Drain Cap

1. INTRODUCTION

a. This work package contains the following instructions:

- Preserving requirements - general
- Preserving requirements
- Represerving requirements
- Cold engine preserving
- Hot (IDLE) engine preserving
- Nonrotating-engine preserving
- Rotating-engine represerving

2. PRESERVING REQUIREMENTS - GENERAL.

CAUTION

- Under no circumstances shall preserving oil be sprayed into inlet or exhaust end of engine. Dirt particles deposited on blades and vanes during operation will alter airfoil shape and adversely affect compressor efficiency.
- Failure to comply with proper preserving requirements during storage or inactivity can result in engine teardown for required bearing and fuel nozzle inspections.
- Engine suspect of internal or external moisture from rain, leakage or condensation shall require a preserving run following engine depreservation.

NOTE

Maintenance personnel should familiarize themselves with T.O. 2J-1-18 (Corrosion Control of Gas Turbine Engines), to determine inactivity period for each engine within 30 days from last engine run.

a. Install closures during inactivity to protect engine from moisture and foreign matter.

CAUTION

Failure to ensure engine is properly packed for shipping or outdoor storage can result in engine damage.

NOTE

Engine packing procedure is not required if engine is shipped in a covered vehicle.

b. Perform engine packing procedure using polyethylene (plastic) shroud or flexible, reusable container.

(1) Refer to T.O. 2J-F100-53-5, WP 043 00 for packing engine in polyethylene (plastic) shroud.

(2) Refer to T.O. 2J-F100-53-5, SWP 043 02 for packing engine in flexible, reusable engine container.

c. Indoor storage is required during inactivity.

d. Depreserving is not required for returning engine to service.

3. PRESERVING REQUIREMENTS.

(See Table 1.)

a. Engine shall be preserved according to requirements in table 1.

4. REPRESERVING REQUIREMENTS.

(See Table 2.)

CAUTION

Failure to represerve engine during storage or inactivity can require engine teardown for bearing and nozzle inspections.

a. Represerve engine before preserving expires.

b. Represerve engine per table 2.

Table 1. Preserving Requirements

Inactivity/Shipping Status	Preserving Procedure
Engine to be inactive less than 45 days	**CAUTION** To prevent internal corrosion and drying of seals and gaskets during inactivity up to 45 days keep fuel system full at all times. 1. Engines to be operated within 45 days do not require preserving. 2. Keep fuel system full to prevent corrosion and deterioration of seals. 3. Oil may be drained to prevent leakage and consequent leakage out of breather pressurization value (BPV).
Engine to be inactive over 45 days: • engine shipment • less than 30 days since last run	Perform one of the following procedures: 1. Cold engine preserving per paragraph 5. 2. Hot engine preserving per paragraph 6. 3. Nonrotating-engine preserving per paragraph 7. (Nonrotational engines only.) 4. Rotating-engine represerve per paragraph 8, and nonrotating-engine preserving per paragraph 7.
Engine to be inactive over 45 days • engine shipment • 30 to 45 days since last run • engine moisture level suspect	Perform hot preserving per paragraph 6. (Use alternate step e.)

Table 2. Represerving Requirements

Initial Preserving Procedure	Preserving Expiration	Represerving Procedure
Cold engine preserving	180 days	Depreserve engine. Represerve engine.
Hot engine preserving	180 days	Depreserve engine. Represerve engine.
Nonrotating-engine preserving (nonrotating engines only)	180 days	Teardown engine before preserving expires - not renewable.
Rotating-engine preserving and nonrotating-engine preserving	90 days	CAUTION This preservation procedure may be renewed once. Represerve per rotating engine represerving procedure.
Rotating-engine preserving	90 days	Depreserve engine. Represerve engine.
High moisture levels suspected	Immediately	Depreserve engine. Represerve engine using alternate procedure.

5. COLD ENGINE PRESERVING.
(See Figures 1 through 3.)

NOTE

- Engine may be hot-engine preserved per paragraph 6 as an option to this procedure.
- Preserving fluid shall conform to MIL-L-6081, Grade 1010 specifications.
- If engine has not been operated within 45 days or if moisture inside engine is suspect, perform step a. If engine has been operated within 45 days and moisture is not suspect, go to step b.

a. If engine has not been operated within 45 days or if moisture inside engine is suspect operate as follows:

(1) Start engine per WP 210 00

(2) Operate engine at IDLE for 5 minutes.

(3) Move throttle to approximately 10,500 N2 rpm. Stabilize two minutes.

(4) Move throttle to IDLE. Stabilize five minutes.

(5) Shut down engine.

(6) Shut test cell fuel valve.

WARNING

- Ensure fuel and preserving oil supply are shut off.
- Ensure main fuel pump cover is installed on the side opposite the fuel/preserving oil supply coupling assembly.

b. Drain fuel at fuel inlet adapter bleed port.

WARNING

Engine ignition can occur when engine is motored with one or both main igniters connected to exciters and generator.

c. Deactivate engine ignition circuit using one of the following procedures:

(1) Deactivate engine ignition circuit by depressing main ignition disable switches on engine control panel. Lights will illuminate to indicate switches are OFF.

(2) Alternate procedure to step c.(1): deactivate ignition circuit by removing P119 cable connector. Install protective cover on generator stator terminal. (See figure 1.)

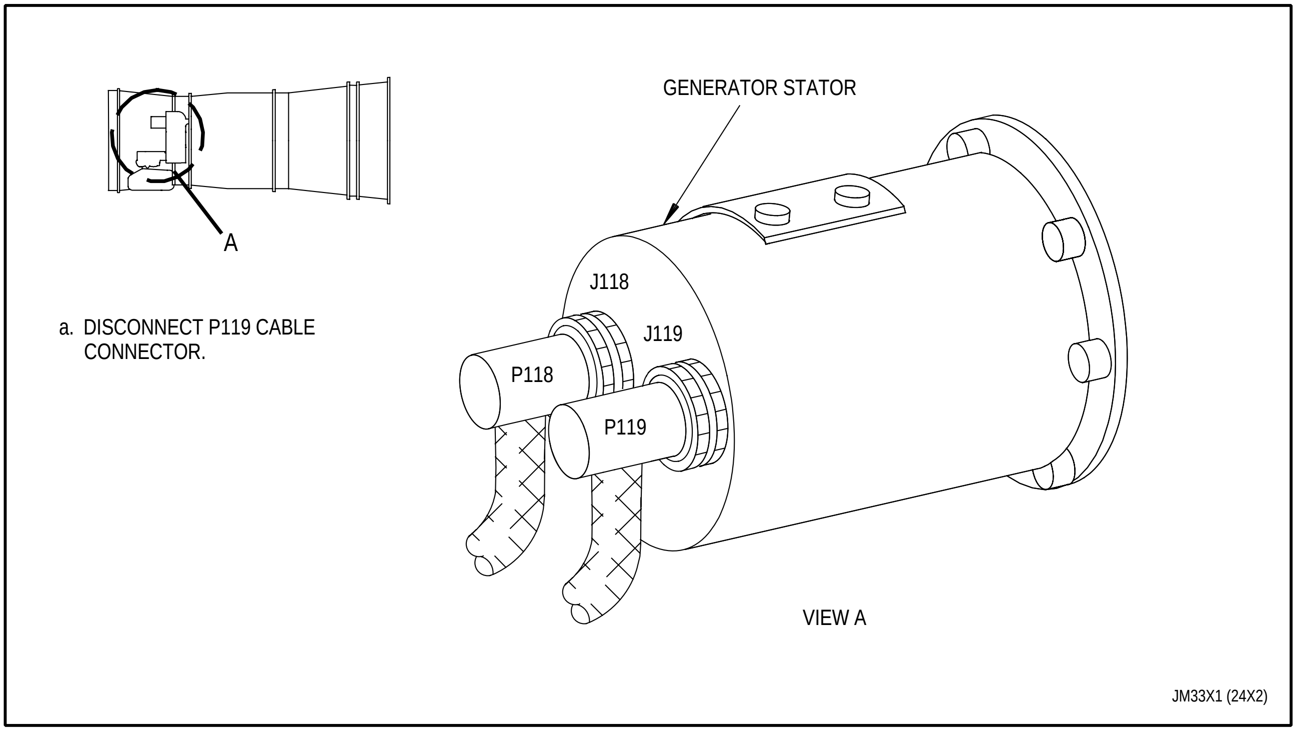


Figure 1. Generator Stator Cable Connector - Removal

d. Prepare fuel system for preserving as follows:

CAUTION

Extreme care shall be taken to prevent foreign material from entering engine fuel system. Preserving oil supply to pump inlet shall contain standard 25 micron filter and shall possess a positive head pressure.

(1) Disconnect Pf1 hydraulic fuel return tube as follows:

(a) Disconnect Pf1 hydraulic fuel return tube between CIVV actuator and augmentor fuel control return tube.

(b) Apply PWA 550 antigalling compound or equivalent to threads of coupling nut and tee.

(c) Install drain line on tee fitting.

(d) Install drain line with approximately 0.040 inch orifice on Pf1 tube coupling nut.

(2) Disconnect bearing return flow tube from augmentor fuel pump as follows:

(a) Disconnect bearing return flow tube from augmentor fuel pump.

(b) Apply PWA 550 antigalling compound or equivalent to threads of tube coupling nut.

(c) Install drain lines on bearing return flow tube coupling nut and augmentor fuel pump tube boss.

(3) Place suitable drain containers under OD-1, OD-2, CIVV, and augmentor fuel pump Pf1 drain lines.

e. Check oil tank sight gage for oil.

(1) If oil is visible on sight gage, drain oil prior to motoring engine per step o. and return to step f. This procedure drains the oil twice, ceasing oil leakage during engine inactivity.

(2) If oil was drained over 45 days previous and represerving is required, service engine as required per WP 109 00.

f. Open preserving oil supply valve.

g. Circulate preserving oil through engine as follows:

CAUTION

- Make sure throttle is in CUTOFF and ignition off.
- Moving throttle past Intermediate (MIL) can introduce preserving oil into augmentor sprayrings. During engine operation after preservation, this oil turns to coke and restricts fuel flow in the sprayrings. This can damage the augmentor and reduce engine performance.
- Do not motor engine for more than 2 1/2 minutes at one time or starter gearbox may be damaged. Follow motoring with 5 minute cool down. Motor engine at a minimum of 2500 N2 rpm.

NOTE

Cool engine for 1 hour prior to preservation if engine has been run at IDLE or above for more than 5 minutes.

(1) Motor engine to 2500 N2 rpm minimum per WP 110 00.

(2) Motor engine until a minimum of 4 gallons of preservation oil is collected from the CIVV Pf1 hydraulic fuel return tube.

(3) Stop motoring.

h. Reconnect Pf1 hydraulic fuel return tube assembly as follows:

(1) Remove drain lines from CIVV actuator tube and augmentor fuel control tube tee.

(2) Apply PWA 550 antigalling or equivalent to threads of coupling nut.

(3) Reconnect CIVV actuator tube to augmentor fuel control return tube (Pf1). Torque coupling nut 150 to 165 pound-inches and lockwire using PN MS9226-04 wire.

i. Reconnect bearing return flow tube as follows:

(1) Remove drain lines from bearing return flow tube and augmentor fuel pump.

(2) Apply PWA 550 antigalling compound or equivalent to threads of coupling nut.

(3) Reconnect bearing return flow tube to augmentor fuel pump. Torque coupling nut 150 to 165 pound-inches and lockwire using PN MS9226-04 wire.

j. Motor engine at 2500 rpm minimum per WP 110 00, and do the following:

(1) Turn SECONDARY mode on.

(2) Cycle throttle from CUTOFF to Intermediate (MIL) five times.

(3) Return throttle to CUTOFF when preservation oil fogs from exhaust nozzle.

(4) Turn PRIMARY mode on.

(5) Move throttle to part power. Stabilize 15 seconds.

(6) Cycle throttle from part power to CUTOFF five times or until preserving oil fogs from exhaust nozzle.

(7) Move throttle CUTOFF.

(8) Motor engine for 15 seconds to clear fumes from exhaust nozzle.

(9) Stop motoring.

k. Shut off and remove preserving oil supply as follows:

(1) Shut off preserving oil supply.

(2) Place suitable drain container under MFP inlet.

(3) Remove Pfo diagnostic cap from the MFP to allow excess preservation oil to drain into container.

(4) Disconnect preserving oil supply line from MFP. Allow excess preserving oil to drain into container.

(5) Install protective cover on MFP inlet.

l. Purge DEEC/EDU fuel-cooling tubes as follows:

(1) Remove preserving oil supply from DEEC/EDU fuel-cooling inlet.

(2) Remove DEEC/EDU fuel-cooling diagnostic cap from quick-disconnect coupling tee.

(3) Apply air pressure, 30 psig maximum, to DEEC/EDU fuel cooling tube and quick-disconnect coupling tee until preservation oil is completely drained from Pfo diagnostic tap.

m. Install DEEC/EDU fuel-cooling diagnostic cap as follows:

(1) Apply PWA 550 antigalling compound or equivalent to threads of DEEC/EDU fuel-cooling diagnostic cap.

(2) Install DEEC/EDU fuel-cooling diagnostic cap on quick-disconnect tee. Torque cap 65 to 70 pound-inches.

n. Install Pfo diagnostic cap as follows:

(1) Apply PWA 550 antigalling compound or equivalent to threads of Pfo diagnostic cap.

(2) Install Pfo diagnostic cap on MFP. Torque cap 65 to 70 pound-inches.

o. Drain residual engine oil as follows: (See figure 2.)

(1) Drain oil through drain and sampling valve as follows:

(a) Remove cover from oil tank drain and sampling valve.

(b) Install PWA 51192 drain cap on oil tank drain and sampling valve.

(c) Allow oil to drain from tank.

(d) Remove PWA 51192 drain cap and install valve cover.

(2) Alternate to step (1): drain oil from tank as follows:

(a) Remove drain and sampling valve from tank and discard packing.

(b) Allow oil to drain from tank into container.

(c) Lubricate PN ST1051-10 packing with MIL-L-7808 engine oil and install on drain and sampling valve.

(d) Install drain and sampling valve in oil tank and torque 50 to 75 pound-inches.

CAUTION

Ensure drained sampling valve is properly lockwired. Valve can become unscrewed during engine operation, resulting in oil loss and damage to engine bearings.

(e) Lockwire drain and sampling valve with PN MS9226-05 wire.

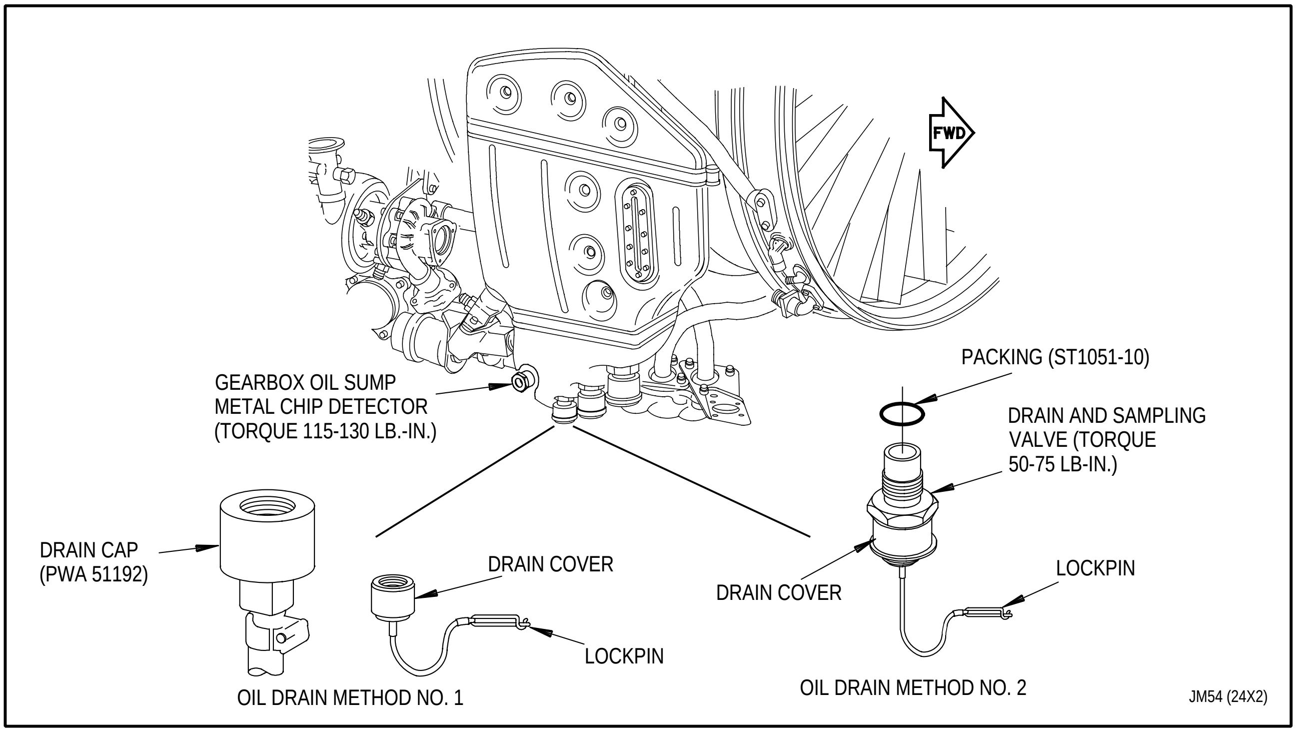


Figure 2. Lubricating Oil Tank Assembly - Draining

(3) Drain oil from gearbox as follows:

(a) Remove chip detector from gearbox.

(b) Allow oil to drain into container.

(c) Lubricate PN ST1001-10 with MIL-L-7808 engine oil and install on chip detector.

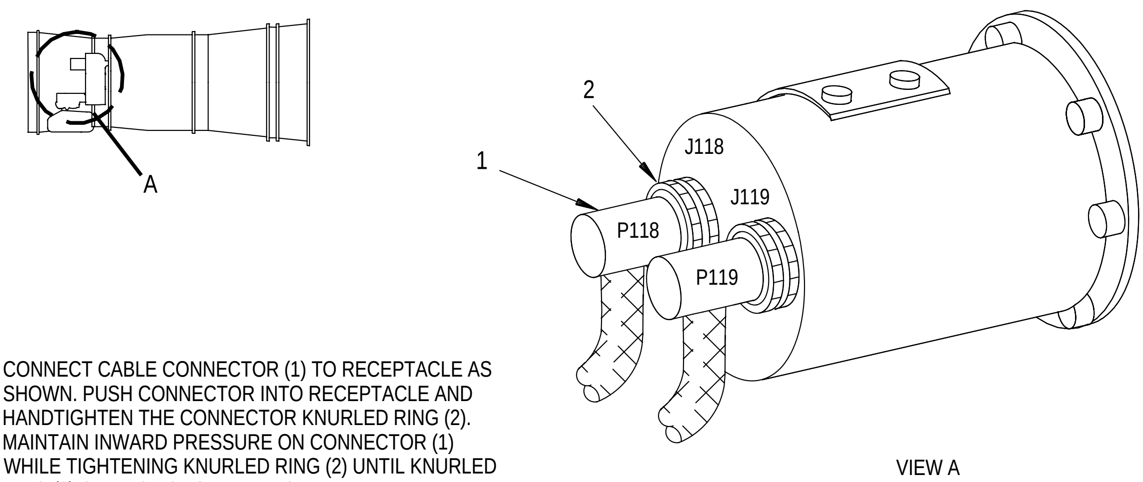
(d) Install chip detector in gearbox and torque 115 to 130 pound-inches.

CAUTION

Ensure gearbox chip detector is properly lockwired. Chip detector can become unscrewed during engine operation, resulting in oil loss and damage to engine bearings.

(e) Lockwire chip detector with PN MS9226-04 wire.

p. Reactivate engine ignition circuit by depressing main ignition disable switches on engine control panel or reinstalling P119 cable connector on generator stator terminal. (See figure 3.)



a. CONNECT CABLE CONNECTOR (1) TO RECEPTACLE AS SHOWN. PUSH CONNECTOR INTO RECEPTACLE AND HANDTIGHTEN THE CONNECTOR KNURLED RING (2). MAINTAIN INWARD PRESSURE ON CONNECTOR (1) WHILE TIGHTENING KNURLED RING (2) UNTIL KNURLED RING (2) CAN NO LONGER BE TIGHTENED BY HAND.

b. SHAKE CABLE CONNECTOR (1). THERE SHALL BE NO RELATIVE MOTION BETWEEN CABLE AND RECEPTICLE. IF THERE IS, REMOVE CABLE CONNECTOR AND REPEAT STEP a.

JM34X1 (24X2)

Figure 3. Stator Generator Cables - Installation

NOTE

- Shut off valves in filter head prevent further draining of system when filter is removed.
- Provide suitable container when removing oil filter.

q. Remove, clean and install main oil filter element per T.O. 2J-F100-53-4, WP 030 00.

r. Remove engine from test cell per WP 307 00 and WP 402 00.

s. Remove tooling from engine, as required, per WP 401 00.

6. HOT ENGINE PRESERVING.

(See Figure 4.)

a. Preserving requirements:

(1) Provide approximately 15 gallons of MIL-L-6081, Grade 1010 oil, as required for a five-minute engine run at IDLE. Supply tank should contain at least 40 gallons.

(2) Preserving oil supply pressure should be at least 25 psig.

NOTE

This preserving procedure requires run engine on preserving oil for five minutes at IDLE. If fuel supply line is same line used to supply preservation oil, time it takes to purge the fuel out of line shall be calculated and documented per following step c.

b. Calculate time (Tpurge) required to purge fuel from supply line with preserving oil per figure 4. If previously calculated, go to step c.

c. Preserve engine as follows:

CAUTION

Moving throttle past Intermediate (MIL) can introduce preserving oil into augmentor sprayrings. During engine operation after preservation, this oil turns to coke and restricts fuel flow in the sprayrings. This can damage the augmentor and reduce engine performance.

NOTE

Perform alternate step e. if last engine run was 30 to 45 days or engine moisture level is suspect.

(1) Start engine and operate at IDLE on normal fuel supply per WP 210 00.

(2) Change engine fuel supply to preserving oil by operating test cell control valves.

(3) Run engine at IDLE for Tpurge minutes (calculated in step b.) to purge fuel from supply line.

(4) Run engine at IDLE on preserving oil for 5 minutes.

(5) Shut down engineper WP 225 00.

(6) Shut off test cell preserving oil supply.

(7) Drain engine oil tank and gearbox, paragraph 5, step o.

d. Alternate preserving for engines inactive 30 to 45 days or suspected to contain moisture:

(1) If oil was drained and preserving is required, service engine oil system as required per WP 109 00.

A. RECORD ALL MEASUREMENTS AND CALCULATIONS IN TABLE BELOW FOR TEST FACILITY USING THE HOT PRESERVING PROCEDURE.

RECORD

LOCATION			
TEST FACILITY			
LENGTH (inches)			
DIAMETER (inches)			
VOLUME (inches^3)			
Tpurge (minutes)			

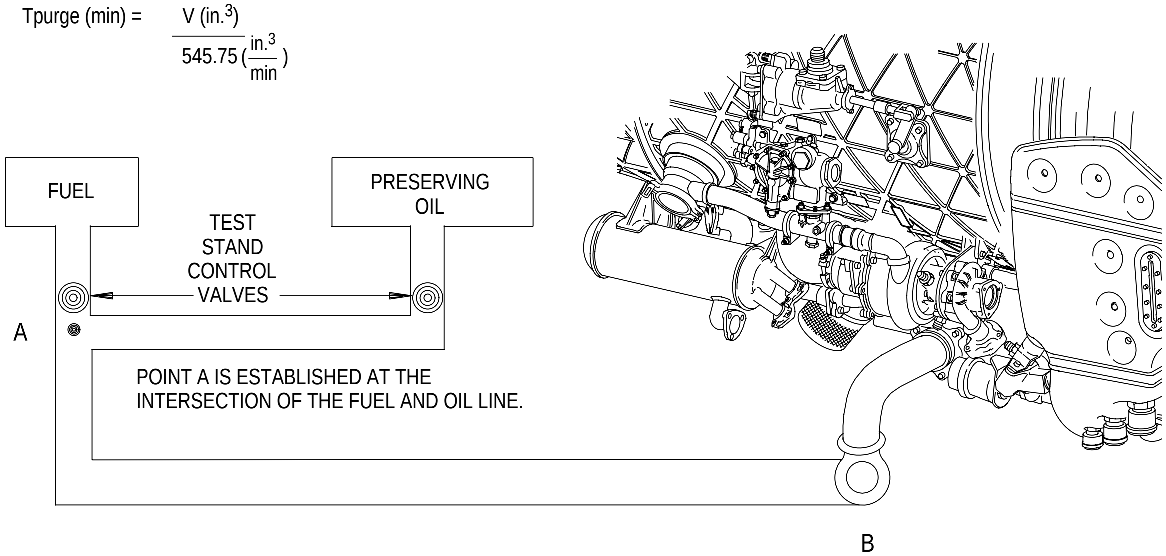
1. MEASURE LENGTH (L) OF SUPPLY LINE IN INCHES FROM POINT A TO POINT B (SEE SCHEMATIC) AND RECORD.
2. MEASURE INSIDE DIAMETER (D) OF SUPPLY LINE IN INCHES AND RECORD.
3. CALCULATE VOLUME OF SUPPLY LINE IN CUBIC INCHES USING FOLLOWING EQUATION:

$$\text{VOLUME (in.}^3\text{)} = \frac{3.141\ D^2\ (\text{in.}^2)\ L\ (\text{in.})}{4}$$

B. RECORD CALCULATION

CALCULATE THE TIME TO PURGE FUEL FROM SUPPLY LINE IN MINUTES USING THE FOLLOWING EQUATION:

$$\text{Tpurge (min)} = \frac{V\ (\text{in.}^3)}{545.75\ \left(\frac{\text{in.}^3}{\text{min}}\right)}$$



54477 (48X2)

Figure 4. Hot (Idle) Engine Preservation - Equipment Schematic and Tpurge Calculation

(2) Start engine and operate at 10,500 N2 rpm for 2 minutes on normal fuel supply per WP 210 00.

(3) Change engine fuel supply to preserving oil by operating the test cell control valves.

(4) Run engine at IDLE for Tpurge minutes (calculated in step b.) to purge fuel from supply line.

(5) Run engine at IDLE on preserving oil for 5 minutes.

(6) Shut down engine in per WP 225 00.

(7) Shut off test cell preserving oil supply.

(8) Drain engine oil tank and gearbox, paragraph 5 step o.

e. Remove engine from test cell per WP 307 00 and WP 402 00.

f. Remove tooling from engine, as required, per WP 401 00.

7. NONROTATING-ENGINE PRESERVING.
(See table 1.)

NOTE

- The following procedure is performed on nonrotating engines requiring preserving per paragraph 2 and table 1 of this work package.
- This procedure may be performed on M37 test stand or other approved support equipment.
- Before performing this procedure, ensure fuel system pressure is bled and fuel system temperature is cool to warm.

a. Prepare engine fuel system for preserving as follows:

CAUTION

- Extreme care shall be taken to prevent foreign material from entering engine fuel system. Preserving oil supply shall be filtered through a 2 to 10 micron filter.
- Maintain PWA 50096 hydraulic cart pressure at 25 to 35 psig or damage to fuel system can occur.
- Use only MIL-L-7808 lubricating oil or VV-P-236 petrolatum to lubricate preformed packings.

NOTE

If engine fuel system is contaminated during this procedure, fuel system components shall be overhauled after procedure is completed.

(1) Provide overboard drain containers as needed including separate container where specified flow is required.

(2) Drain DEEC/EDU cooling system as follows:

(a) Remove diagnostic cap from DEEC/EDU cooling quick-disconnect coupling tee.

(b) Attach drain hose to diagnostic port and direct to overboard container.

(c) After all fuel has drained DEEC/EDU cooling system remove drain hose and reinstall diagnostic cap. Torque cap 65 to 70 pound-inches.

(3) Disconnect augmentor fuel pump (AFP) bearing cooling tube from Pf1 manifold tee.

(a) Attach drain hose to AFP bearing cooling tube and direct to overboard drain container.

(b) Install temporary cap on Pf1 tube tee.

(4) Make sure main fuel pump (MFP) inlet (Pfo) is open and all fuel has drained.

(5) Disconnect Pf1 tube from MFP and install temporary cap on pump port.

(6) Disconnect CIVV control and cylinder Pf1 return tube from Pf1 manifold tee.

(a) Attach drain hose to CIVV Pf1 return tube and direct to overboard drain container.

(b) Attach drain hose to Pf1 manifold tee and direct to overboard drain container.

(7) Remove Pf1 return tube assembly as follows:

(a) Disconnect Pf1 return tube coupling nut from Pf1 drain port on main fuel control (MFC).

(b) Remove all clamps associated with Pf1 return tube.

(c) Disconnect Pf1 return tube tee and coupling nut from Pf1 bypass and install temporary cap on bypass.

(d) Disconnect Pf1 bypass manifold from Pf1 return tube.

(e) Install drain hoses on MFC Pf1 drain port and Pf1 bypass manifold. Direct drain hoses to overboard drain containers.

(8) Disconnect Pf2 tube as follows:

(a) Disconnect Pf2 tube from MFC and MFP.

(b) Install temporary cap on MFP port.

b. Preserve engine fuel system as follows:

(1) Connect PWA 50096 hydraulic cart to Pf2 port on MFC.

(2) Set MFC PLA at IDLE.

(3) Pump MIL-L-6081, Grade 1010 preserving oil at 25 to 35 psig inlet pressure and a minimum temperatire of 60°F into MFC. Continue until at least two gallons of fluid is collected from Pf1 drain port on MFC and fluid runs clear.

(4) Disconnect preserving oil supply form Pf2 port.

(5) Reconnect Pf2 tube as follows:

(a) Reconnect Pf2 tube to MFC. Lubricate coupling nut with PWA 550 antigalling coumpound or equivalent and torque 700 to 800 pound-inches.

(b) Using new PN MS9967-214 packing lubricated with MIL-L-7808 lubricating oil reinstall Pf2 tube on MFP. Lubricate three PN MS9557-09 bolts with MIL-L-7808 lubricating oil, install through tube flange into MFP and torque 75 to 85 pound-inches

c. Preserve pressurizing and dump (P&D) valve as follows:

(1) Remove P&D valve drain tube from P&D valve and OD-1 gang drain.

(2) Connect PWA 50096 hydraulic cart to port on P&D valve.

(3) Pump MIL-L-6081, Grade 1010 preserving oil at 25 to 35 psig inlet pressure and minimum temperature of 60°F into P&D valve port. Pump oil until approximately 1200 cc has been pumped into engine (approximately 10 seconds at 30 psig).

(4) Remove preserving oil supply and allow excess oil to drain from P&D valve port.

(5) Reconnect P&D valve drain tube as follows:

(a) Install tube in ports of P&D valve and gang drain.

(b) Lubricate coupling nuts with PWA 550 antigalling compound or equivalent and torque 135 to 150 pound-inches.

d. Preserve augmentor fuel system:

(1) Make sure all open ports on MFP are capped.

(2) Connect PWA 50096 hydraulic cart to Pfo port on MFP.

(3) Pump MIL-L-608l, Grade 1010 preserving oil at 25 t0 35 psig inlet pressure and a minimum temperature of 60°F into Pfo port. Continue until at least two gallons of fluid has drained from MFC Pf1 return tube.

(4) Install temporary cap on MFC Pf1 drain line.

(5) Allow preserving oil to flow from AFP bearing cooling return and Pf1 return drain lines (from CIVV control, CENC, and AFP controller) until oil runs clear.

(6) Install temporary caps on Pf1 return lines as oil runs clear in order to speed flow through remaining components.

NOTE

Preserving oil will flow very slowly from CENC Pf1 drain line.

(7) Remove preserving oil supply from Pfo port on MFP and install temporary cap on port.

e. Preserve DEEC and EDU cooling systems as follows:

(1) Connect PWA 50096 hydraulic cart to DEEC/EDU fuel cooling inlet quick-disconnect fitting.

(2) Pump MIL-L-6081, Grade 1010 preserving oil at 25 to 35 psig inlet pressure and minimum temperature of 60°F into DEEC/EDU cooling system until fluid runs clear Pf1 return line.

(3) Remove preserving oil supply from DEEC/EDU cooling quick-disconnect fitting.

f. Secure engine fuel system as follows:

(1) Allow excess fluid to drain from engine.

(2) Remove all temporary drain lines and caps from ports and tubes.

(3) Reconnect AFP bearing cooling tube to Pf1 manifold tee. Lubricate coupling nut with PWA 550 antigalling compound or equivalent and torque 270 to 300 pound-inches.

(4) Reconnect Pf1 return tube to MFP. Lubricate coupling nut with PWA 550 antigalling compound or equivalent and torque 350 to 400 pound-inches.

(5) Reconnect CIVV control and cylinder Pf1 return tube to Pf1 manifold tee. Lubricate coupling nut with PWA 550 antigalling compound or equivalent and torque 135 to 150 pound-inches.

(6) Reconnect Pf1 return tube assembly as follows:

(a) Connect Pf1 tube to Pf1 drain port on MFC. Lubricate coupling nut with PWA 550 antigalling compound or equivalent and torque 350 to 400 pound-inches.

(b) Connect Pf1 tube tee to Pf1 bypass. Lubricate coupling nut with PWA 550 antigalling compound or equivalent and torque 500 to 550 pound-inches.

(c) Connect Pf1 tube to Pf1 bypass manifold. Lubricate coupling nut with PWA 550 antigalling compound or equivalent and torque 135 to 150 pound-inches.

(d) Install clamps on tube as required.

g. Secure engine as follows:

(1) Install protective covers on electrical connectors, engine openings, and gearbox PTO pad per T.O. 2J-F100-53-5, WP 004 00.

(2) Install oil resistant cover on gearbox PTO drive pad.

(3) Drain engine lubricating oil from main gearbox and oil tank. Allow engine to stand until all excess oil has drained.

8. ROTATING-ENGINE REPRESERVING.
(See Figures 5 through 15.)

NOTE

- These instructions do not require test cell motoring to preserve an engine.
- Representing is required to recoat rotating, oil-wetted areas. This procedure fills each bearing compartment from the bottom ID of the inner race to the middle of the rotor shaft. The PTO shaft is then rotated 1/4 turn at a time, allowing bearing parts to soak, ensuring that rotating parts are recoated with oil.
- For engines removed directly from test cell operation, T.O. 2J-1-18 applies. Until final AGE is available, locally provided drain valves, fittings, caps to hold oil in compartments, and locally manufactured cover to block breather preassurizing valve port in gearbox can be installed, provided this improvised equipment does not damage or contaminate oil system.

a. Provide the following equipment from local sources:

- Petcock or drain valve to replace oil sump metal chip detector for No. 2 and 3 bearing compartment.
- PWA 51103 adapter.
- Locally manufacture cover to block breather pressurizing valve port in gearbox.
- PMU29/E tank and pump unit. (Add pressure gage to fill line.)
- Hose and fittings to connect scavenge lines and gearbox.
- Plates to block off numbers 1, 4 and 5 scavenge pump ports.
- Cap for boost pump oulet.
- Cap for main pump inlet.
- Approximately eight gallons of MIL-L-7808 lubricating oil.

b. If oil tank has not been drained, drain oil per paragraph 5.

c. Replace oil sump metal chip detector with petcock or drain valve.

(1) Remove chip detector in gearbox from its mating check valve by pushing in on scalloped knob of chip detector and turn knob to left. Remove check valve and packing. Remove packings.

(2) Replace chip detector with petcock or drain valve.

d. Remove oil tank, transfer tube, and cone strainer element assembly per T.O. 2J-F100-53-4, WP 031 00.

e. Cap off transfer tube fitting.

f. Cap main oil pump inlet port from which cone strainer element assembly was removed.

g. Remove oil tank breather manifold assembly from gearbox. (See figure 5.)

(1) Remove pressure transmitter.

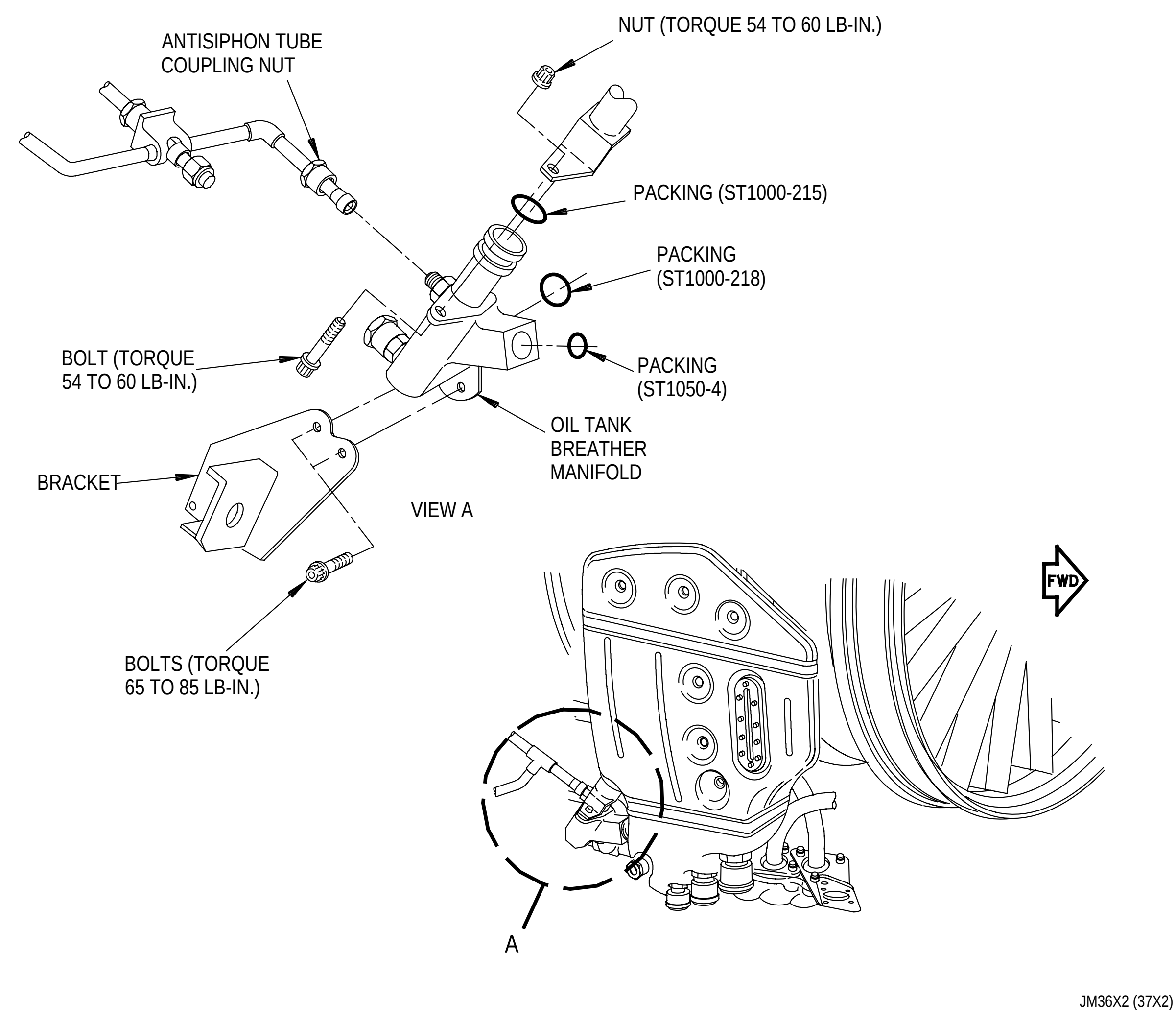


Figure 5. Oil Tank Breather Manifold Assembly - Removal

(2) Disconnect tube coupling nut at connection of antisiphon tube and breather manifold and cap tube.

(3) Remove bolts holding oil pressure transmitter bracket and breather manifold to gearbox.

(4) Remove breather manifold. Remove and discard packing from ends of breather manifold.

h. Install PWA 51103 adapter on triangular pad marked BREATHER on right side of gearbox housing. Secure with nuts. (See figure 6.)

i. Remove breather pressurizing valve assembly from gearbox. (See figure 6.)

j. Locally manufacture cover to block breather pressurizing valve port in gearbox.

k. Disconnect No. 2 and 3 bearing pressure tube and main pump inlet pressure manifold from oil filter. (See figure 6.)

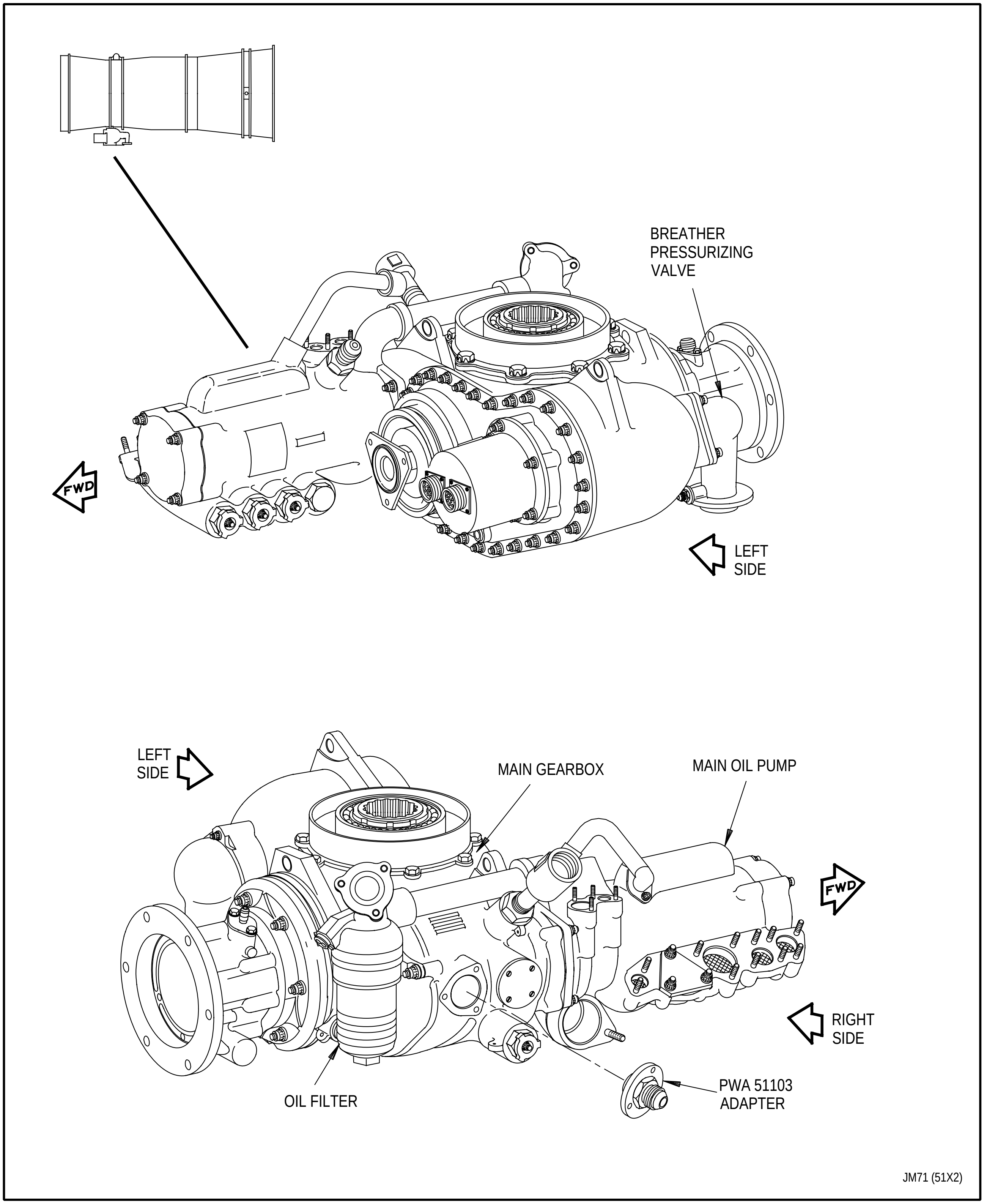


Figure 6. Breather Pressurizing Valve and Main Oil Filter Location, and PWA 51103 Adapter - Installation

l. Disconnect main bearing outlet pressure manifold from adapter at main oil pump boost pump outlet by turning tube nut. (See figure 7.)

m. Fill boost pump through adapter of pump outlet with MIL-L-7808 lubricating oil cap adapter.

n. Disconnect three tubes (No. 5, 1 and 4 bearing scavenge tubes) from side of main pump assembly by removing nuts. Remove and discard packings. Place protective caps on tubes. Cap ports in pump.

o. Disconnect oil tank scavenge tube from upper pad by removing nuts. Remove and discard packing. Place protective cap on manifold.

p. Fill scavenge pumps with MIL-L-7808 lubricating oil through scavenge pump discharge port. Cap port.

q. Check if remote gearbox driveshaft coupling is installed. If coupling is installed, go to step r. If not, install coupling per WP 005 00.

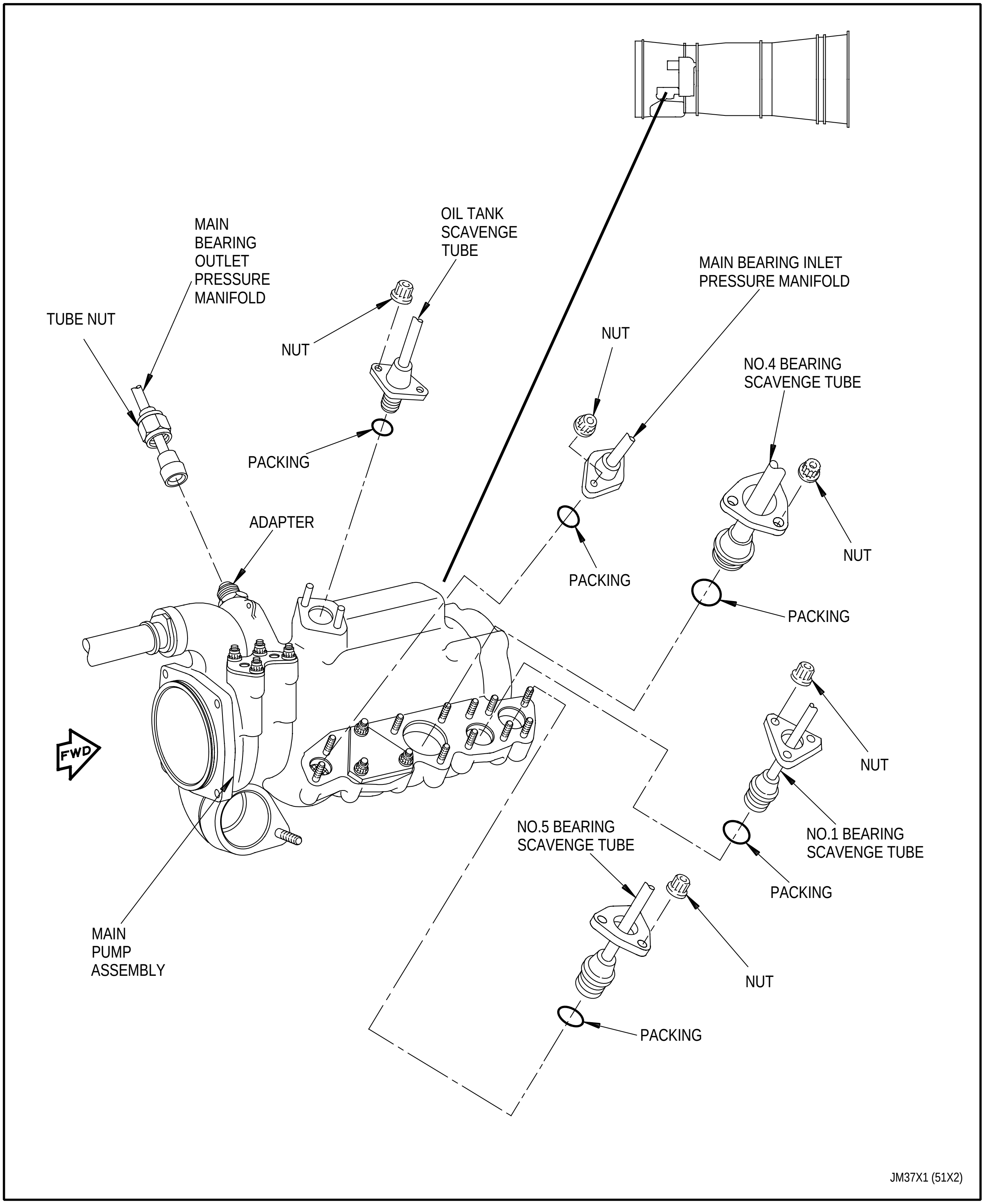


Figure 7. Main Pump Assembly Tubes and Manifolds - Removal

r. Attach fill line from tank and pump unit PMU-29/E to PWA 51103 adapter at breather manifold port.

CAUTION

To prevent oil leakage through carbon seals, do not allow fill pressure to exceed 10 psi.

NOTE

Steps s. and t. maybe done simultaneously with step r., if desired.

s. Pump six gallons of MIL-L-7808 into breather manifold port. Using standard wrench, turn PTO coupling shaft 1/4 turn and let stand for one minute, for six coupling revolutions.

t. Reach through fan inlet stator vanes and rotate N1 rotor in same manner as step s. above for a total of five fan revolutions.

u. Drain oil using drain valve or petcock installed in gearbox.

v. Disconnect No. 1 bearing oil scavenge tube from rear of tee connector on bottom of fan inlet case. (See figure 8.)

w. Disconnect No. 4 bearing oil scavenge tube directly below No. 4 bearing compartment. Remove bolts, then disengage scavenge tube. Remove and discard packing. (See figure 8.)

x. Disconnect No. 5 bearing oil scavenge tube at fitting directly below No. 5 bearing compartment. (See figure 9.)

(1) Remove bolts and nuts securing tube clamps.

(2) Disconnect coupling nut.

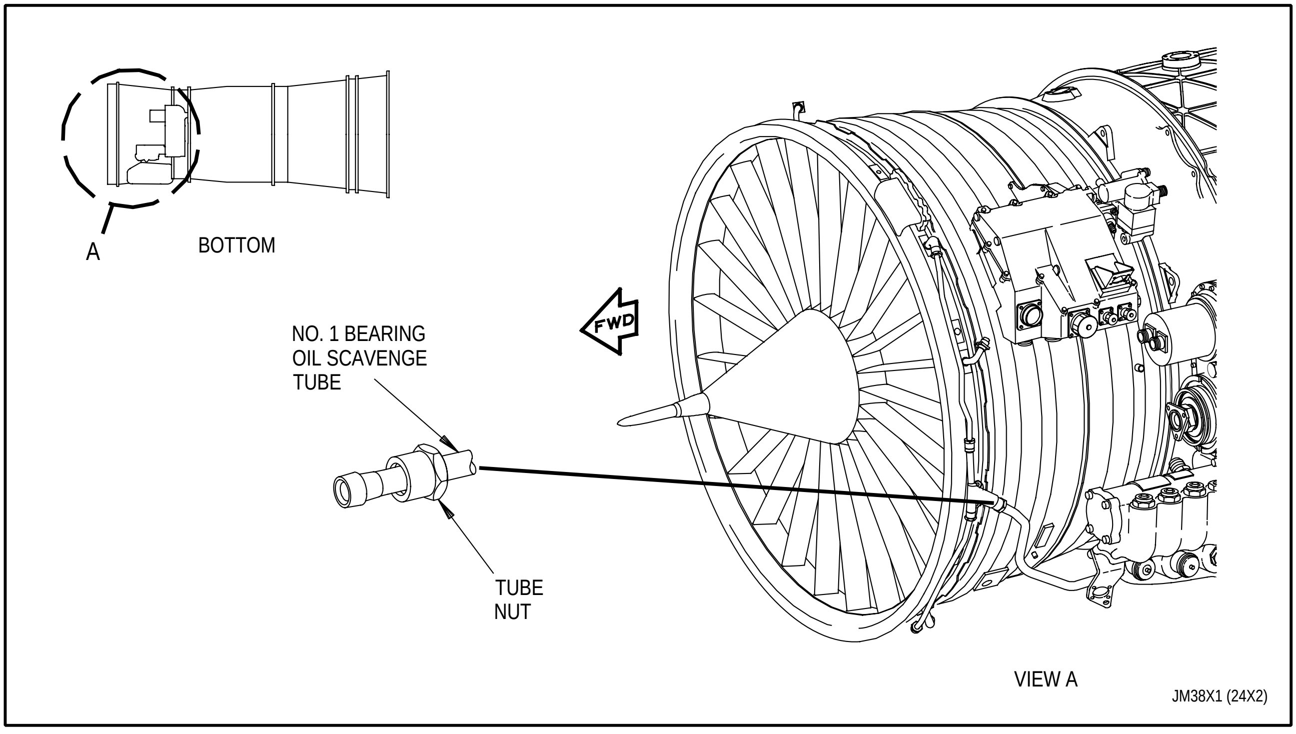


Figure 8. No. 1 Bearing Oil Scavenge Tube - Disconnecting

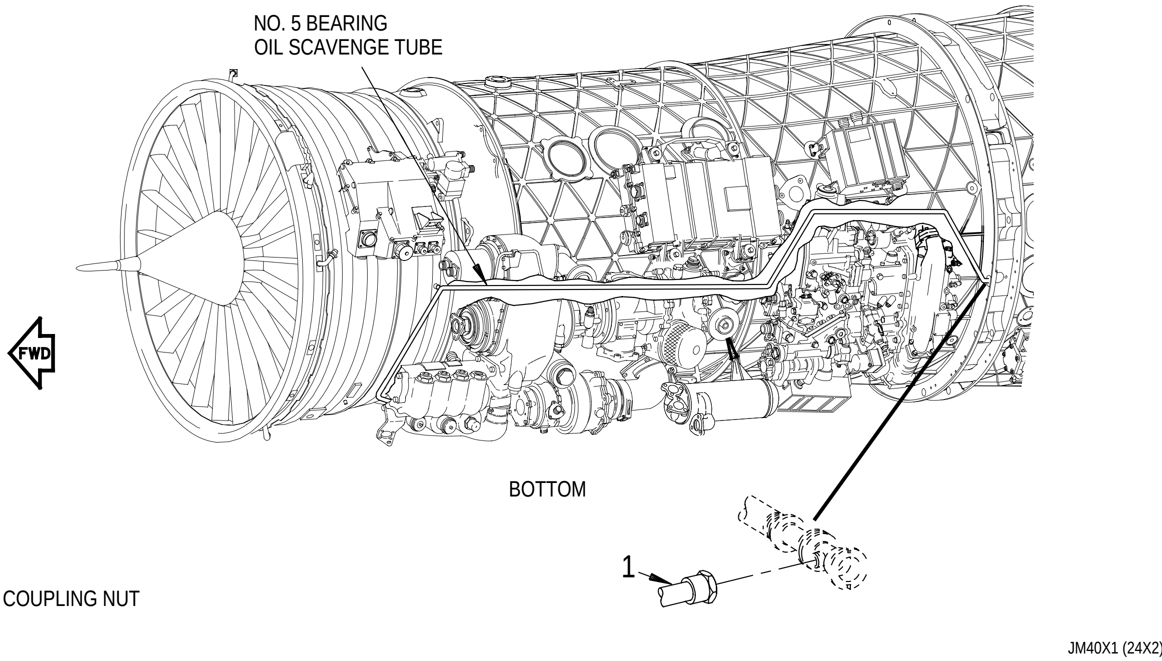


Figure 9. No. 5 Bearing Oil Scavenge Tube - Disconnecting

CAUTION

The small capacity of Nos. 1, 4 and 5 bearing compartments require acccuracy and close attention to fill volumes specified. Ensure that hose from tank and pump unit is full of oil prior to connecting to bearing compartment.

y. Attach fill line from tank and pump unit PMU-29/E to each of the bearing compartment scavenge fittings shown in steps v., w., and x. above. Fill each compartment to volumes as follows:

BEARING COMPARTMENT	FILL VOLUME
1	3 ± 1/2 pint
4	3 1/2 ± 1/2 pint
5	2 1/2 ± 1/2 pint

z. Rotate rotors similar to steps s. and t. above.

aa. Drain each compartment after completion of rotation.

ab. Connect No. 1 bearing oil scavenge tube to tube tee at bottom of inlet fan case. Torque tube nut(1) 500 to 525 pound inches and lockwire. (See figure 10.)

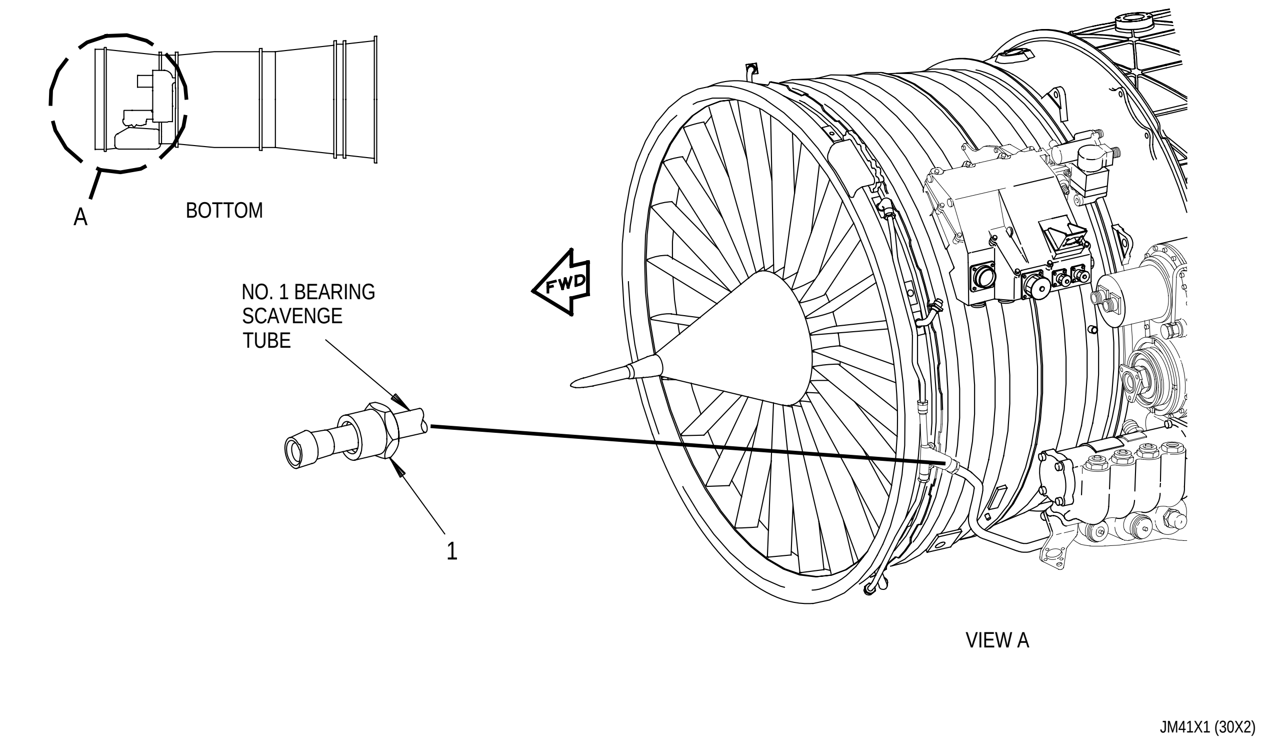
ac. Reconnect No. 4 bearing oil scavenge tube. (See figure 11.)

(1) Coat packing(1) with lubricating oil and install in groove at end of scavenge tube fitting.

(2) Insert scavenge tube into the transfer tube.

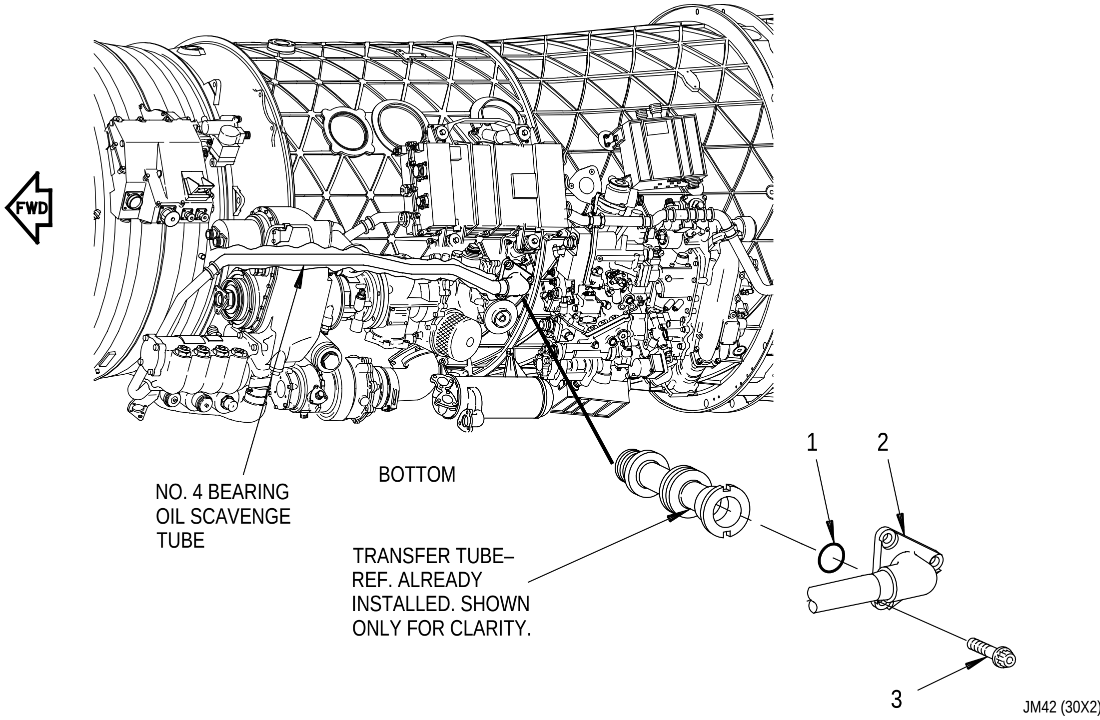
(3) Lubricate bolts(2) with PWA 550 antigalling compound or equivalent.

(4) Install bolts to secure tube. Torque 27 to 30 pound-inches.



INDEX NUMBER	DESCRIPTION	LUBRICATION	TORQUE (LB–IN.)	LOCKWIRE
1	TUBE NUT	PWA 550	500–550	MS9226–04

Figure 10. No. 1 Bearing Oil Scavenge Tube - Reconnecting



INDEX NUMBER	DESCRIPTION	LUBRICATION	TORQUE (LB–IN.)	LOCKWIRE
1	PN ST 1000–019 PACKING	LUBRICATING OIL	–	–
2	SCAVENGE TUBE	–	–	–
3	BOLT	PWA 550	27–30	–

Figure 11. No. 4 Bearing Oil Scavenge Tube - Reconnecting

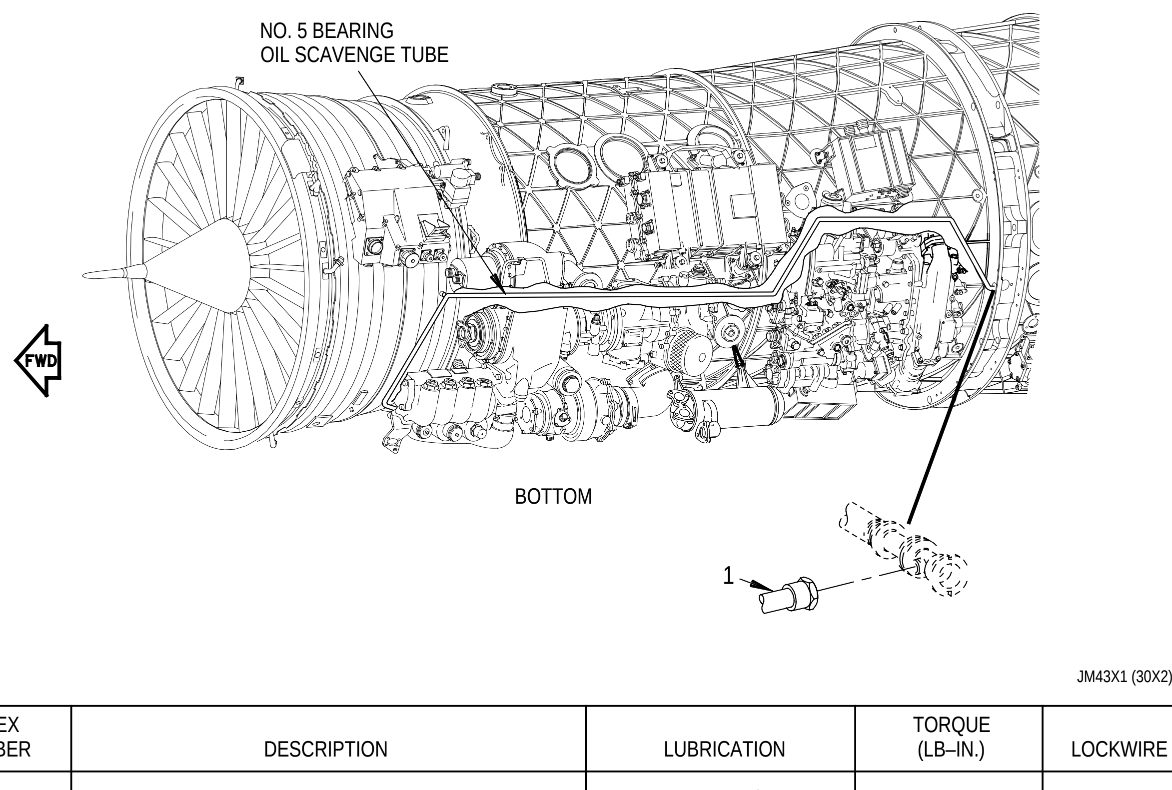
ad. Reconnect No. 5 bearing oil scavenge tube. (See figure 12.)

(1) Reconnect tube clamps as shown. Lubricate coupling nut(2) with PWA 550 antigalling compound or equivalent.

(2) Connect No. 5 bearing oil scavenge tube to tube tee. Torque coupling nut(1) 350 to 400 pound-inches and lockwire.

ae. Remove protective cap from oil tank scavenge tube. Install lubricated PN ST1050-016 packing in grooves of tube. Position tube in place on top of main pump and install nuts. Torque nuts 23 to 26 pound-inches.

af. Remove protective caps from Nos. 5, 1, and 4 bearing scavenge ports on side of main pump. Reconnect three tubes (Nos. 5, 1, and 4 bearing scavenge tubes) to side of main pump assembly. (See figure 13.)



INDEX NUMBER	DESCRIPTION	LUBRICATION	TORQUE (LB–IN.)	LOCKWIRE
1	NO. 5 BEARING SCAVENGE TUBE COUPLING NUT	PWA 550	350–400	MS9226–04

Figure 12. No. 5 Bearing Oil Scavenge Tube - Reconnecting

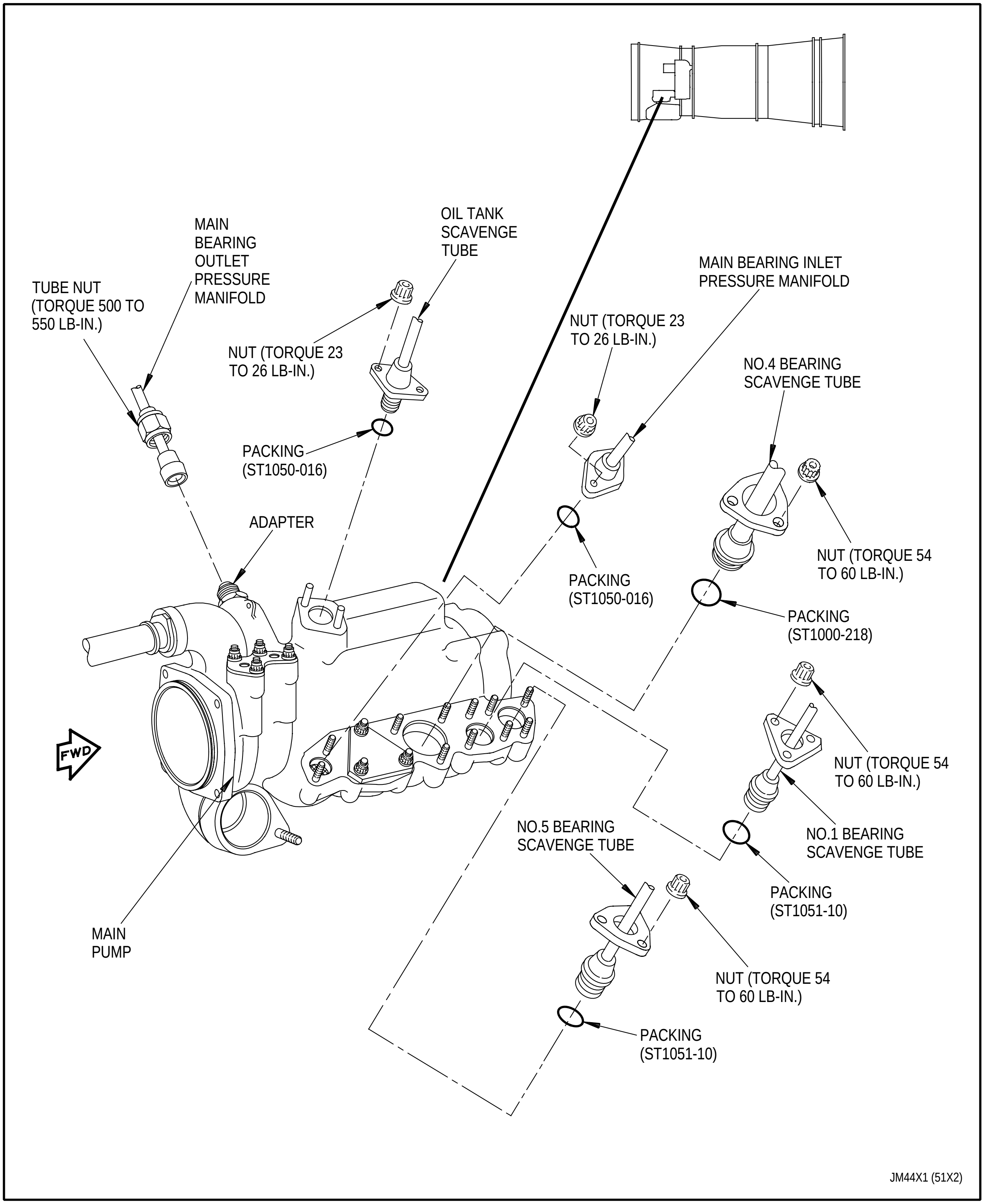


Figure 13. Main Pump Assembly Tubes and Manifolds - Assembly

ag. Reconnect main bearing outlet pressure manifold to adapter at boost pump outlet of main pump.

ah. Reconnect No. 2 and 3 bearing pressure tube and main pump inlet pressure manifold to oil filter.

ai. Remove locally manufactured cover blocking breather pressurizing valve port in gearbox.

aj. Reinstall breather pressurizing valve assembly to gearbox per T.O. 2J-F100-53-4, WP 027 00.

ak. Remove cap from fitting on which transfer tube was installed. Remove cap from main oil pump inlet port.

al. Reinstall oil tank transfer tube and cone strainer element assembly.

am. Remove PWA 51103 adapter from triangular pad marked BREATHER on right side of gearbox housing.

an. Reinstall tank breather manifold assembly and oil pressure transmitter bracket to gearbox. (See figure 14.)

CAUTION

Use only MIL-L-7808 oil or VV-P-236 petrolatum to lubricate preformed packing.

(1) Coat packings with lubricating oil and install at both ends of oil tank breather manifold assembly.

(2) Put a light coat of PWA 550 antigalling compound or equivalent on threads of bolts and secure breather manifold to gearbox pad with oil pressure transmitter bracket angle outward. Do not tighten bolts since it is necessary for them to be loose when installing pressure transmitter in following step.

ao. Reinstall pressure transmitter. (See figure 14.)

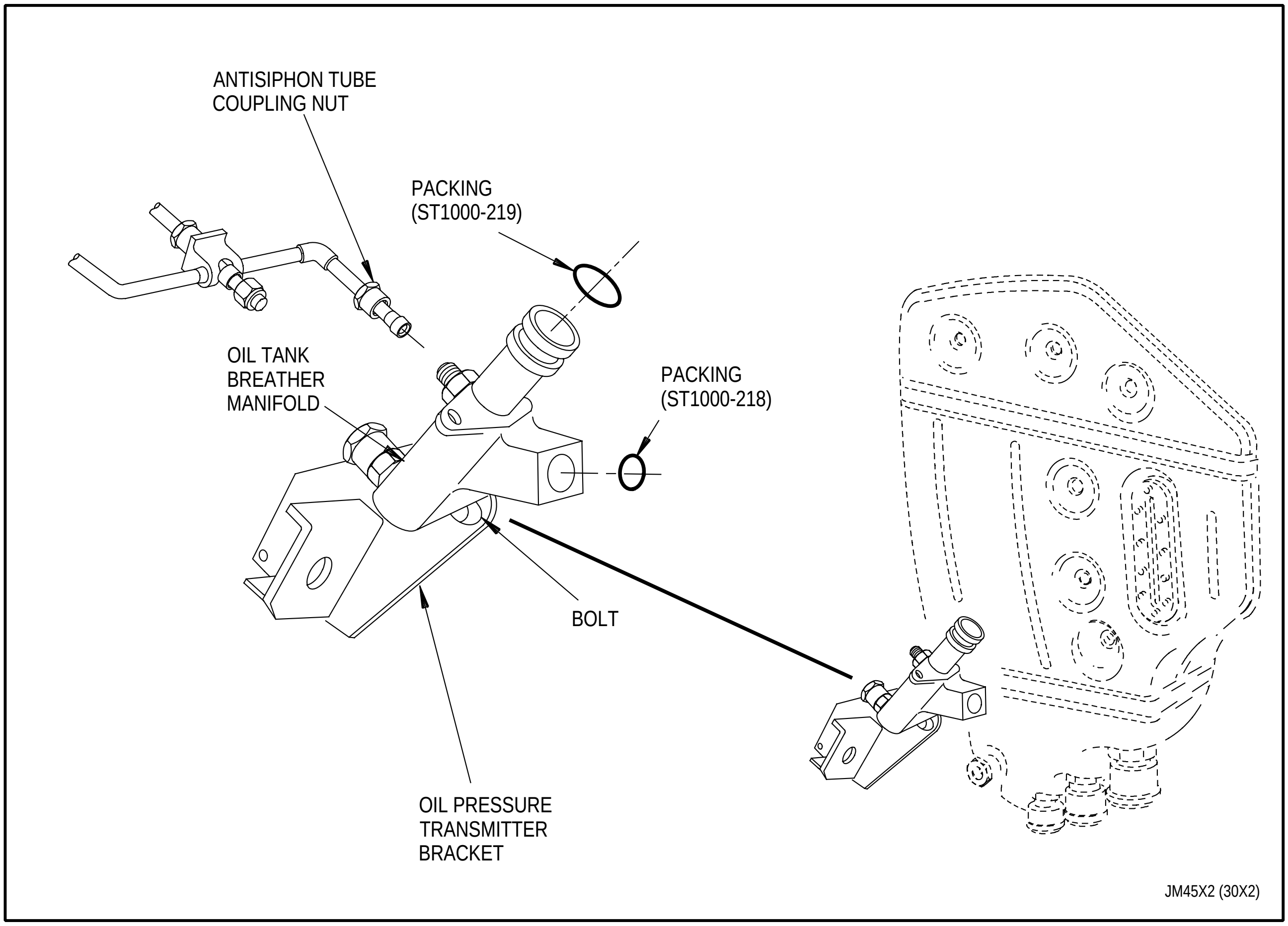


Figure 14. Oil Tank Breather Manifold Assembly And Oil Pressure Transmitter Bracket - Reinstallation

ap. Reconnect antisiphon tube to breather manifold.

(1) Lightly coat PWA 550 antigalling compound or equivalent on threads of antisiphon tube coupling nut.

(2) Connect antisiphon tube to breather manifold. Tighten and torque coupling nut 65 to 75 pound-inches. Lockwire coupling nut to adjacent coupling nut at tee connection with PN MS9226-04 lockwire.

aq. Reinstall oil tank per T.O. 2J-F100-53-4, WP 031 00.

ar. Reinstall oil sump metal chip detector.

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE AND AF 8624150 TEST CELL ADAPTER REMOVAL FROM AF 8624151 THRUST FRAME

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

None

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains instructions for preliminary undress and engine removal from AF 8624151 thrust frame.

2. ENGINE REMOVAL FROM THRUST FRAME.
(See Figures 1 and 2.)

a. Disengage thrust frame coupling plate(9, figure 1), coupling plate DISENGAGE(4) light illuminated.

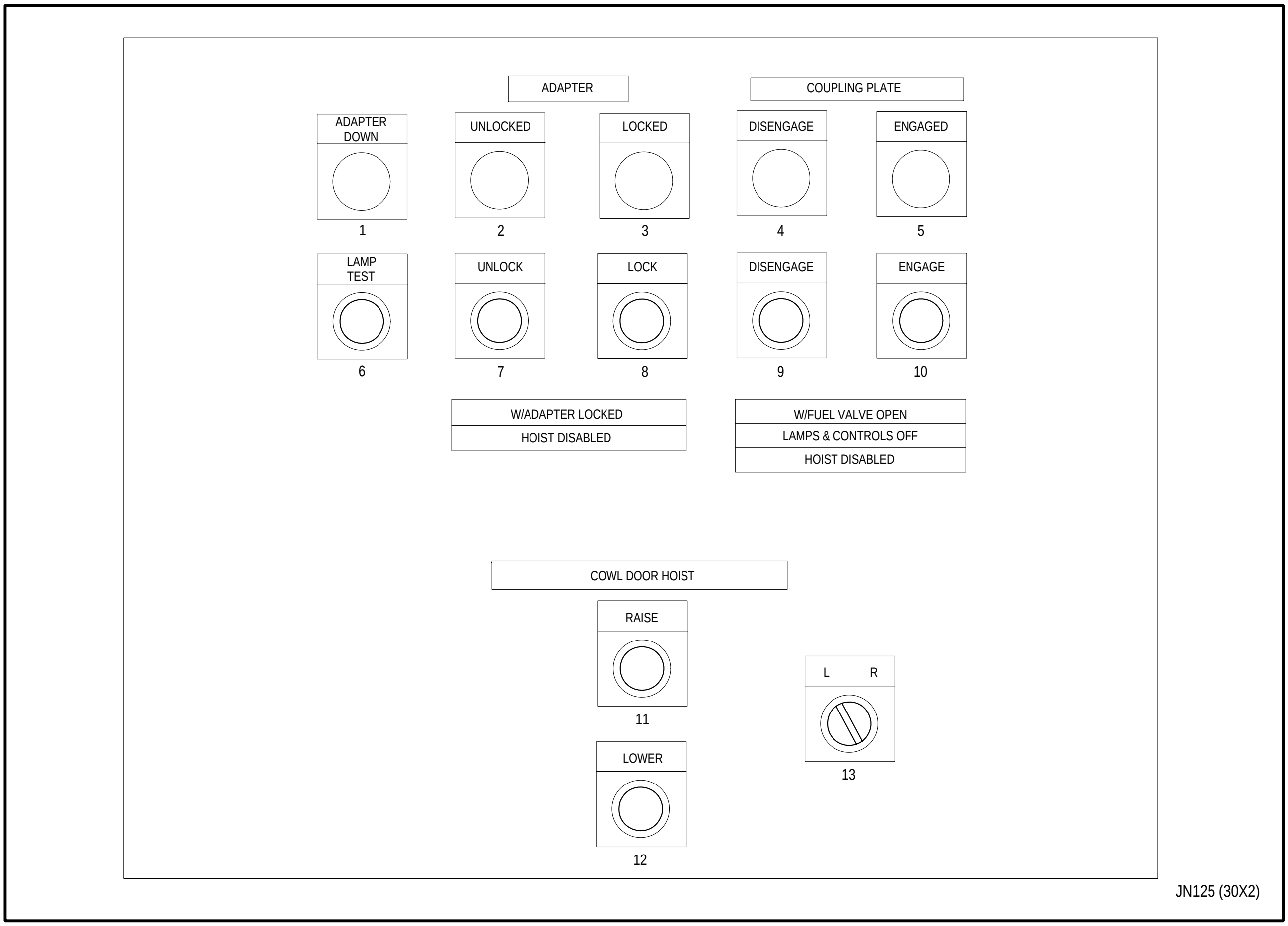


Figure 1. Thrust Stand Control Panel

Legend for figure 1

1. ADAPTER DOWN indicator
2. Adapter UNLOCKED indicator
3. Adapter LOCKED indicator
4. Coupling plate DISENGAGE indicator
5. Coupling plate ENGAGED indicator
6. LAMP TEST push button switch
7. Adapter UNLOCK push button switch
8. Adapter LOCK push button switch
9. Coupling plate DISENGAGE push button switch
10. Coupling plate ENGAGE push button switch
11. Cowl door hoist RAISE push button switch
12. Cowl door hoist LOWER push button switch
13. LR (left/right) switch

b. Remove overboard drain canister from gearbox, OD-1, and OD-2 drain collectors.

c. Remove vibration cables from each accelerometer.

d. Disengage thrust frame adapter locks(7), adapter UNLOCKED(2) light illuminates.

e. Turn hoist pendant on.

NOTE

Full up position is required to ensure clearance of cone bolts on thrust frame and sockets on adapter.

f. Clear monorail path for transport of engine and adapter from test cell.

g. Slowly raise front and rear hoists together to full up position lifting engine and adapter from thrust stand. (See figure 2.)

h. Return engine to work station for engine undress.

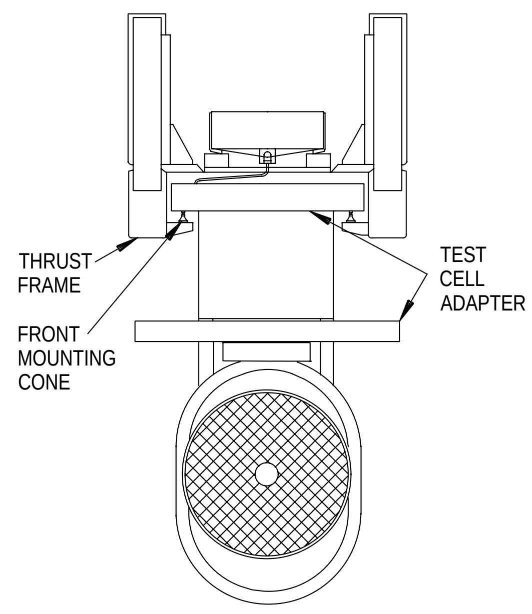


Figure 2. Engine Removal From Thrust Frame

WORK PACKAGE

TECHNICAL PROCEDURES

OIL SYSTEM FLUSHING

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 3	24				
4 Blank	24				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Oil System Servicing	WP 109 00
Engine Start Procedures	WP 210 00
Engine Shutdown	WP 225 00
Joint Oil Analysis Program (JOAP) Wearmetal Guidelines	WP 303 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Filter - Oil	WP 030 00
Detector - Metal Chip, Oil Sump	WP 033 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains oil system flushing procedures required following system failure or contamination.

2. OIL SYSTEM FLUSHING PROCEDURE FOR CONTAMINATION BY FLUIDS OTHER THAN MIL-L-7808 SUCH AS: WATER, FUEL, EMERGENCY OIL, RADAR COOLANT, HYDRAULIC FLUID, SILICONE.

a. Drain entire oil system by draining oil tank, gearbox, oil filter and accessible oil system plumbing.

b. Service oil system with MIL-L-7808 oil per WP 109 00.

c. Start engine and operate at IDLE for 5 minutes per WP 210 00.

d. Shut down engine per WP 225 00.

NOTE

If an emergency oil was used, steps a. through c. are repeated three times.

e. Repeat steps a, b, and c five times or until all contaminating fluids have been removed.

f. If contamination is caused by silicone, continue flushing system until silicone level is 3 ppm or less.

g. Replace oil filter element.

3. OIL SYSTEM FLUSHING PROCEDURE FOR NON-METALLIC SOLID CONTAMINATION (SUCH AS CARBON, DIRT, SLUDGE, RUBBER) OR FOR CONTAMINATION BY EXCESSIVE WEAR METAL AFTER REPAIRS HAVE BEEN COMPLETED.

a. Drain entire oil system by draining oil tank, gearbox, oil filter and accessible oil system plumbing.

b. Remove and flush scavenge system plumbing from contaminated compartment.

c. Replace oil filter element and clean oil filter bowl. Refer to T.O. 2J-F100-53-4, WP 030 00. Clean metal chip detectors. Refer to T.O. 2J-F100-53-4, WP 033 00.

d. Service oil system with MIL-L-7808 oil per WP 109 00.

e. Motor engine for 2 minutes.

f. Repeat steps a, c, d, and e until all contamination is removed.

g. Start engine and operate at IDLE for 5 minutes per WP 210 00. Shut down engine per WP 225 00.

h. Take JOAP sample from oil tank JOAP valve.

i. Inspect and clean chip detectors. Refer to T.O. 2J-F100-53-4, WP 033 00. Inspect and replace oil filter element. Refer to T.O. 2J-F100-53-4, WP 030 00

j. If JOAP sample shows excessive wear metal or chip detectors and oil filter show particles, engine teardown is required to locate contamination source.

k. Place engine on 10-hour JOAP surveillance per WP 303 00.

WORK PACKAGE

INTRODUCTION

ENGINE UNDRESS PROCEDURES

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 2

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	0				

1. INTRODUCTION.

a. This work package introduces the 400 00 through 499 00 series work packages for engine undress procedures. The following work packages are included in this series:

WP No.	Title
401 00	Test Tooling Removal From Engine (Undress)
402 00	Engine Transfer From AF 8624150 Test Cell Adapter to Shipping Support On ALC 3000E Transportation Trailer
403 00 through 499 00	Open

WORK PACKAGE

TECHNICAL PROCEDURES

TEST TOOLING REMOVAL FROM ENGINE (UNDRESS)

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 18

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	10	8	0	12A Added	10
2	7	9 - 11	7	12B Blank Added	10
3 - 5	0	12	9	13	10
6 - 7	7			14 - 16	0

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test -	T.O. 2J-F100-11-2
Engine Leak Check and Gaspath Inspection - - - - - - - - - - -	WP 302 00
Engine Data Clear Using EAU -	WP 668 00
Engine -	T.O. 2J-F100-53-5
Coupling, Remote Gearbox Driveshaft Tube, Oil Tank Scavenge, Tee Oil Filter Tube Removal From Gearbox Module -	WP 111 00
Coupling, Remote Gearbox Driveshaft - Inspection - - - - -	WP 420 00
Coupling, Remote Gearbox Driveshaft Tube, Oil Tank Scavenge, Tee Oil Filter Tube Installation Onto Gearbox	WP 727 00
Gearbox Module -	T.O. 2J-F100-53-11
Removal of Externally Accessible Accessories and Parts -	WP 011 00
Coupling, Remote Gearbox Driveshaft - Inspection - - - - -	WP 332 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
Compond, cleaning	MIL-C-87937 Type I or
Solvent, petrolem	P-D-680, Type II, or Type III
Compound, antigalling (PWA 550)	Hi-T-650 or Lubri-Bond HT
Lockwire (0.025 inch diameter)	MS9226-03
Swab, cotton	-

EXPENDABLE ITEMS

Nomenclature	Part Number	Quantity
Metal seal ring	4076492	1

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains instructions for removing engine test tooling.

2. ENGINE TEST TOOLING REMOVAL (UNDRESS).

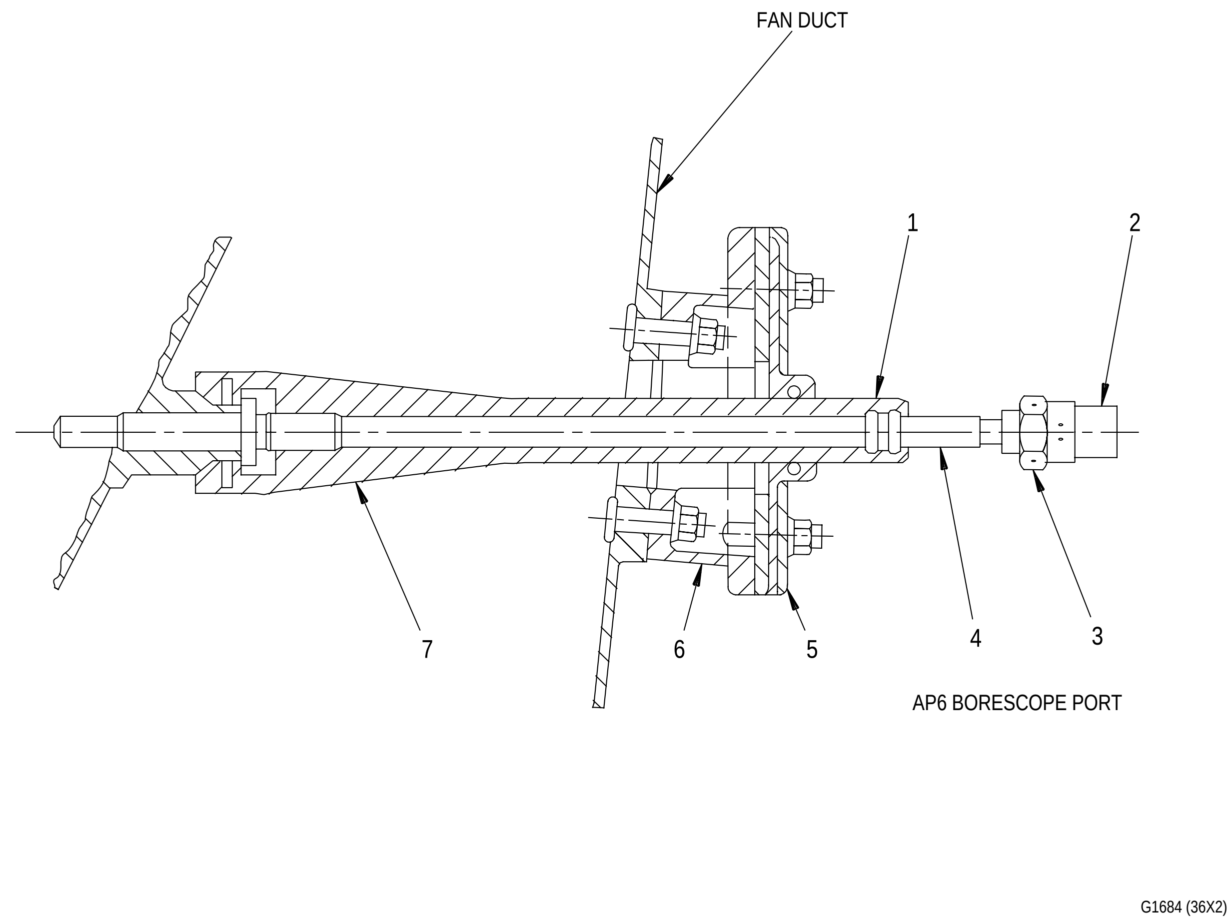
(See Figures 1 through 8.)

a. Install protective covers on engine inlet and exhaust.

NOTE

Engine may be undressed either on test cell adapter or on ALC 3000E transportation trailer.

b. Remove fan drive turbine accelerometer as follows: (See figure 1.)



1. Outer detail
2. Accelerometer (PN 2271A)
3. Locking nut
4. Inner rod
5. Seal plate assembly
6. Base plate
7. Vibration probe (PN 164-1026-1)

Figure 1. AP6 Vibration Probe and Accelerometer - Removal

(1) Remove accelerometer(2, figure 1) from probe assembly(7).

(2) Remove nut(3) from rod(4).

(3) Remove plate(5) from plate(6) of seal assembly.

(4) Remove plate(6) of seal assembly from fan duct port boss studs.

(5) Loosen rod(4) and unlock bayonet plug of outer detail(1) from core boss by turning outer detail 1/4 turn clockwise. Remove vibration probe assembly(7).

(6) Install AP6 borescope plug assembly as follows:

(a) Visually inspect borescope boss for loose grit or dirt. If dirty, clean ID with cotton swab moistened with P-D-680, Type II petroleum solvent, or MIL-C-87937, Type I cleaning compound.

(b) Clean removed borescope plug with P-D-680, Type II petroleum solvent, or MIL-C-87937, Type I cleaning compound.

(c) Apply PWA 550 antigalling compound to area of borescope plug that mates with engine boss.

(d) Thread nuts(2, figure 2) onto studs of AP6 borescope boss on outer rear fan duct.

NOTE

There are two configurations of borescope plugs:

- Flat tab plug rotates counterclockwise to engage.
- 3/8 inch drive plug rotates clockwise to engage.

(e) Insert borescope plug assembly through outer fan duct port into cavity of engine.

NOTE

Borescope plug tip will not be fully engaged into engine cavity until borescope plug cover is parallel to fan duct boss.

(f) Align borescope plug so plug cover is parallel to fan duct boss. Press plug assembly inward to compress spring and rotate plug to engage studs.

(g) Install nuts and tighten alternately to a maximum of two turns at a time until plug is flush with mount boss. Torque nuts 75 to 85 pound-inches.

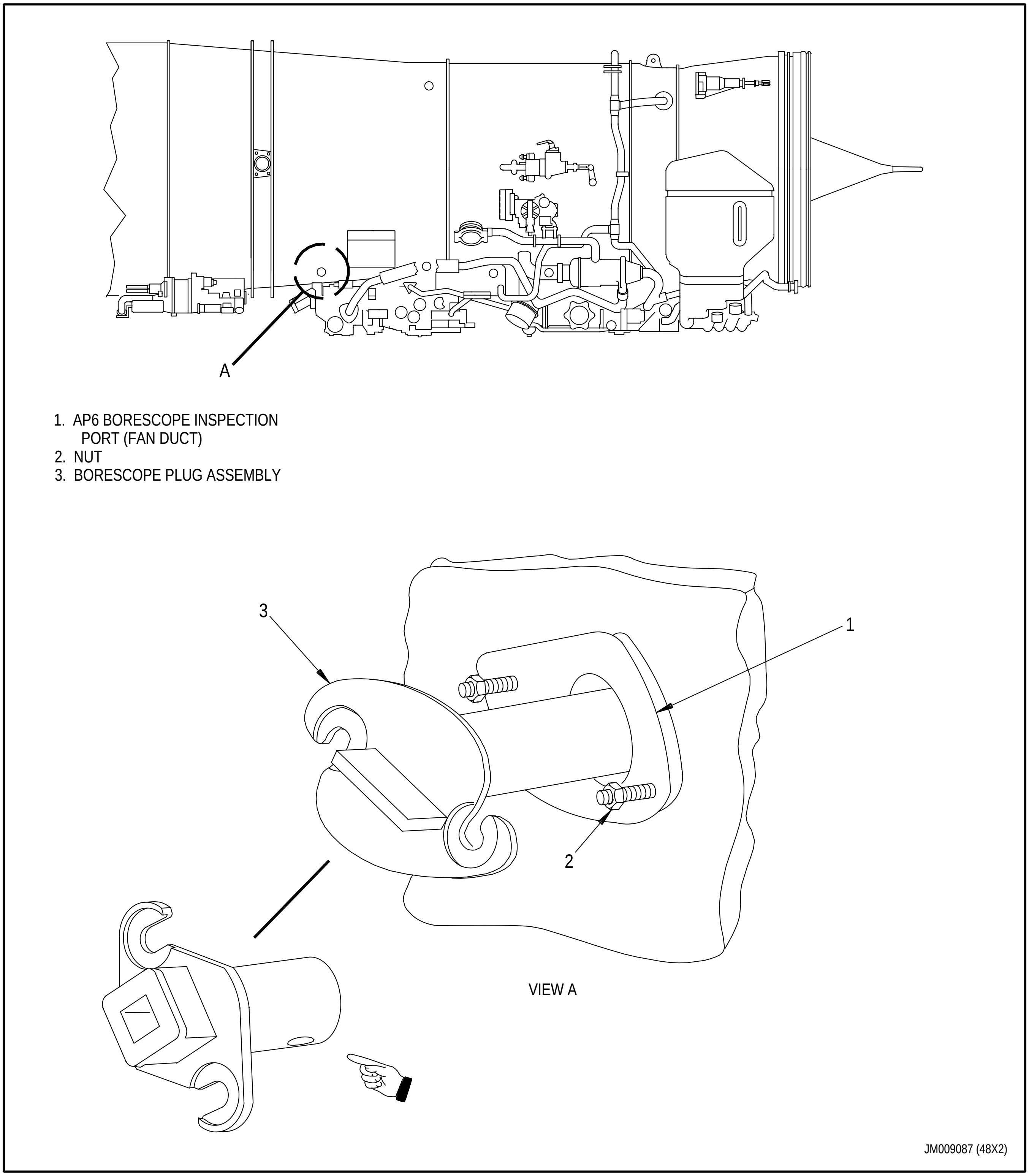


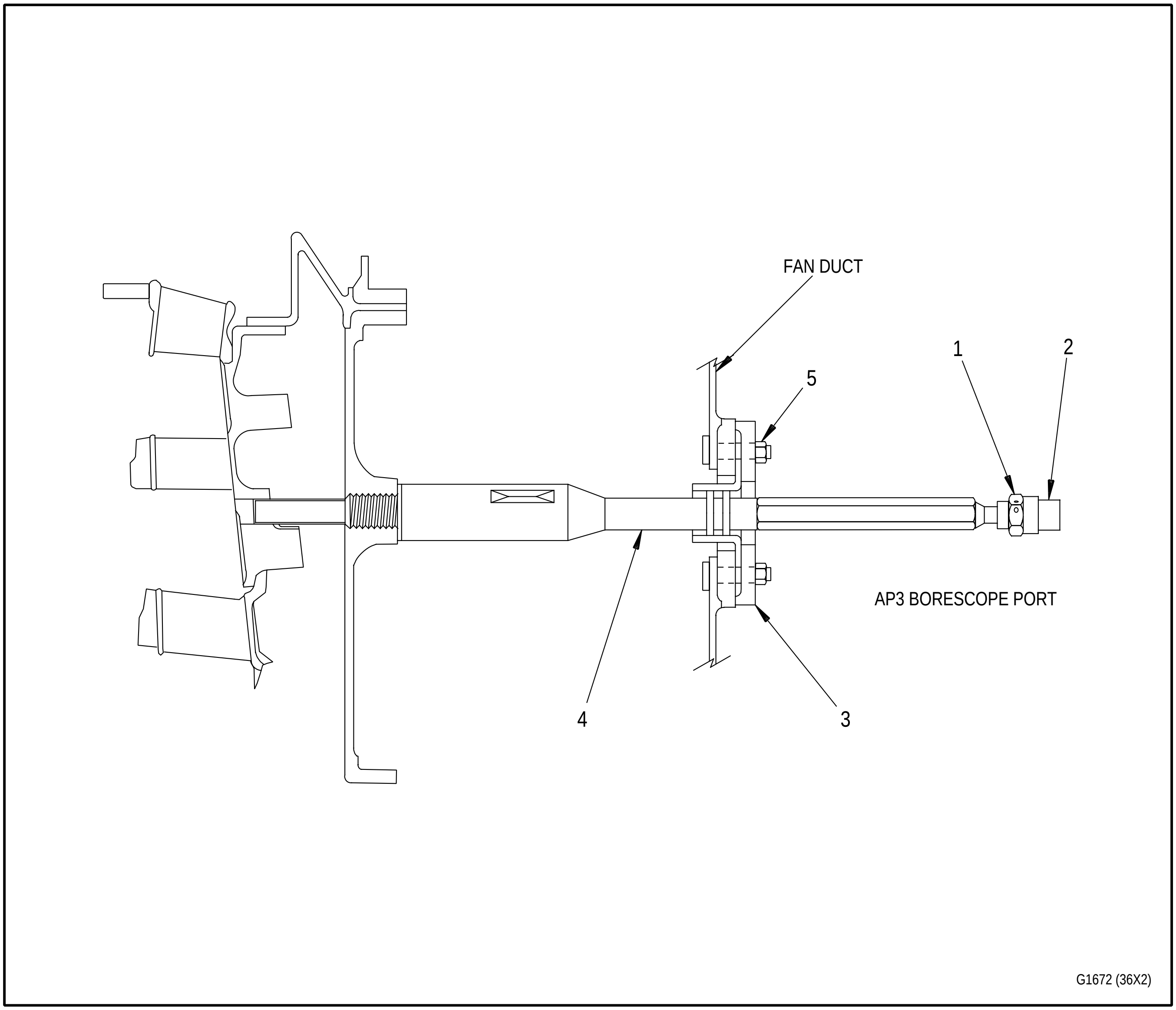
Figure 2. AP6 Borescope Plug Assembly - Installation

c. Remove compressor case accelerometer as follows:

(1) Remove accelerometer(2, figure 3) from probe.

(2) Remove nut(1) from probe(4).

(3) Remove nuts(5) from studs on fan duct port boss.



1. Locking nut
2. Accelerometer (PN 2271A)
3. Cover assembly
4. Vibration probe (PN 164-1025-1)
5. Nuts

Figure 3. AP3 Vibration Probe and Accelerometer - Removal

(4) Remove vibration probe(4) and cover assembly(3).

(5) Install AP3 borescope plug assembly as follows:

(a) Visually inspect borescope boss for loose grit or dirt. If dirty, clean ID with cotton swab moistened with P-D-680, Type II petroleum solvent, or MIL-C-87937, Type I cleaning compound.

(b) Clean removed borescope plug with P-D-680, Type II petroleum solvent, or MIL-C-87937, Type I cleaning compound.

(c) Apply PWA 550 antigalling compound to areas of borescope plug that mate with engine boss.

(d) Thread nuts(3, figure 4) onto studs of AP3 borescope boss on outer front fan duct.

NOTE

There are two configurations of borescope plugs:

- Flat tab plug rotates counterclockwise to engage.
- 3/8 inch drive plug rotates clockwise to engage.

(e) Insert borescope plug assembly through outer fan duct port into cavity of engine.

NOTE

Borescope plug tip will not be fully engaged into engine cavity until borescope plug cover is parallel to fan duct boss.

(f) Align borescope plug so plug cover is parallel to fan duct boss. Press plug assembly inward to compress spring and rotate plug to engage studs.

(g) Install nuts and tighten alternately to a maximum of two turns at a time until plug is flush with mount boss. Torque nuts 75 to 85 pound-inches.

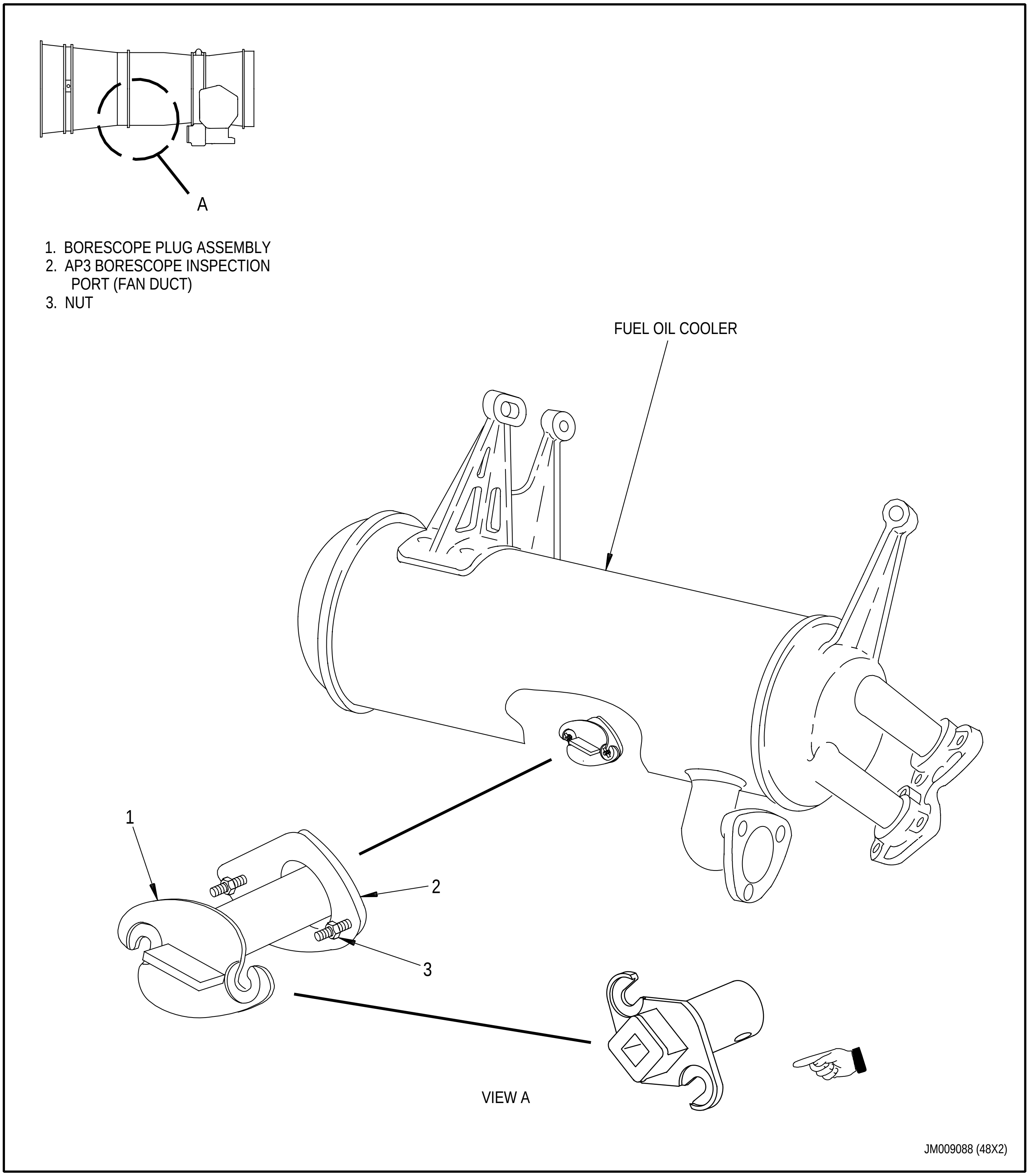


Figure 4. AP3 Borescope Plug Assembly - Installation

d. Remove gearbox accelerometer as follows:

(1) Remove nuts and washers securing accelerometer bracket on gearbox studs and remove bracket with accelerometer.

(2) Remove lockwire and screw mounting accelerometer to bracket. Remove accelerometer from bracket.

(3) Coat threads of studs with PWA 550 antigalling compound. Remove excess compound.

(4) Install washers and nuts on gearbox studs. Torque nuts 54 to 60 pound-inches.

e. Remove fan inlet case accelerometer as follows:

(1) Remove lockwire, and bolt from bracket on inlet case.

(2) Remove accelerometer bracket with accelerometer attached.

(3) Remove accelerometer from bracket.

(4) Apply PWA 550 antigalling compound to bolt threads.

(5) Install bolt into TT2B probe, torque 27 to 30 pound-inches. Lockwire with PN MS9226-03 wire.

NOTE

Ensure PN 103-2034 bolts and PN 103-2035 nuts remain with starter jaw. This hardware is required to maintain starter jaw balance at subsequent installations.

f. Remove starter coupling jaw from PTO pad at gearbox by removing lockwire, detail bolts, and detail nuts.

NOTE

Removal of remote gearbox driveshaft coupling is not required for this inspection.

g. Inspect remote gearbox driveshaft coupling dimensionally and for overstress (see figure 5). Replace if it does not comply with dimensional requirements or if overstress is evident. Refer to T.O. 2J-F100-53-11, WP 332 00 and WP 011 00 for inspection and replacement procedures.

h. Remove safety pins, unlock latch securing augmentor nozzle band assembly and remove from engine.

NOTE

If anti-ice valve was removed perform steps i. and j., otherwise proceed to step k.

i. Remove bolts and nuts securing LM 1004 anti-ice system blank-off plates to anti-ice and air inlet manifolds.

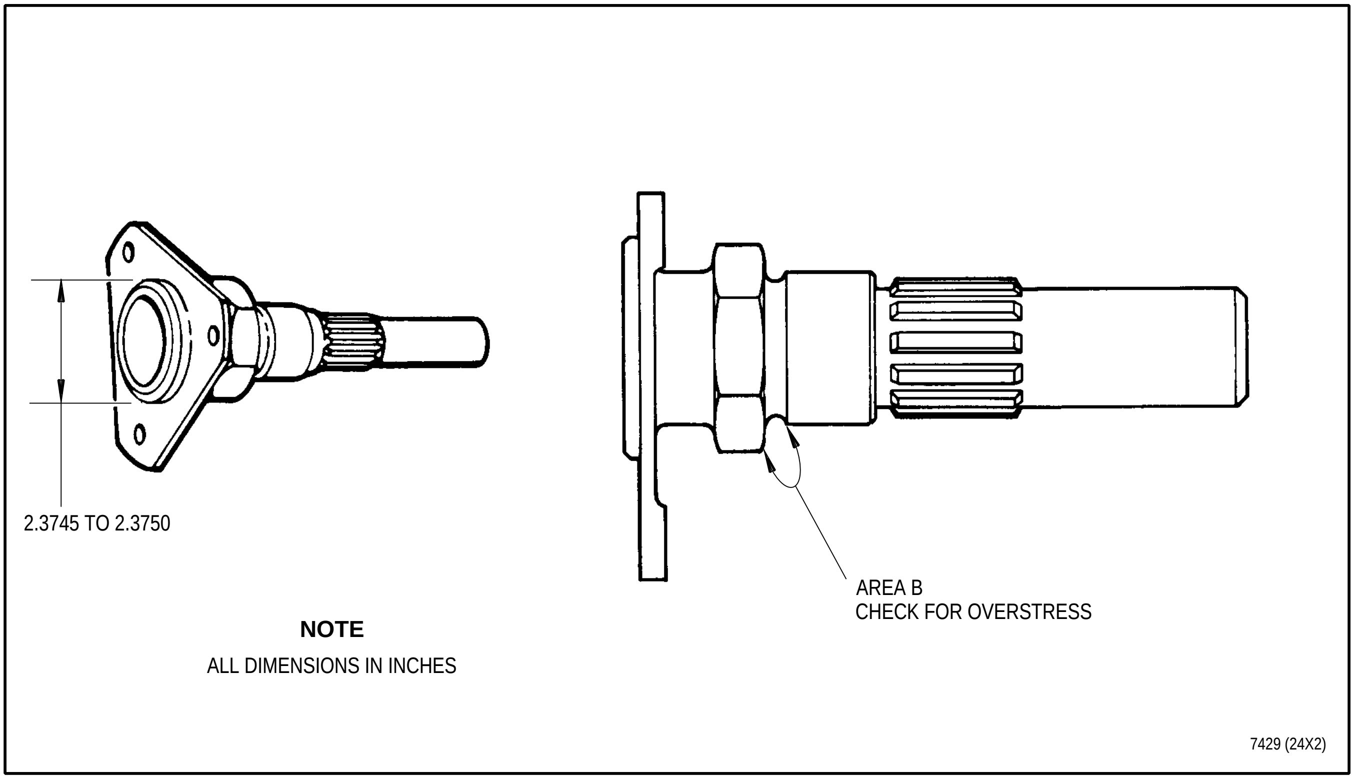


Figure 5. Remote Gearbox Driveshaft Coupling - Overstress Inspection

j. Install anti-ice valve as follows (see figure 6):

NOTE

A thin layer of wax may be used to hold gaskets in place during installation.

(1) Place gasket(4) on rear mating flange of valve(6).

(2) Lightly coat PWA 550 antigalling compound on threads of bolts(1, 3, and 9). Remove excess.

(3) Install bolt(1) bolt head rearward through air supply manifold(2).

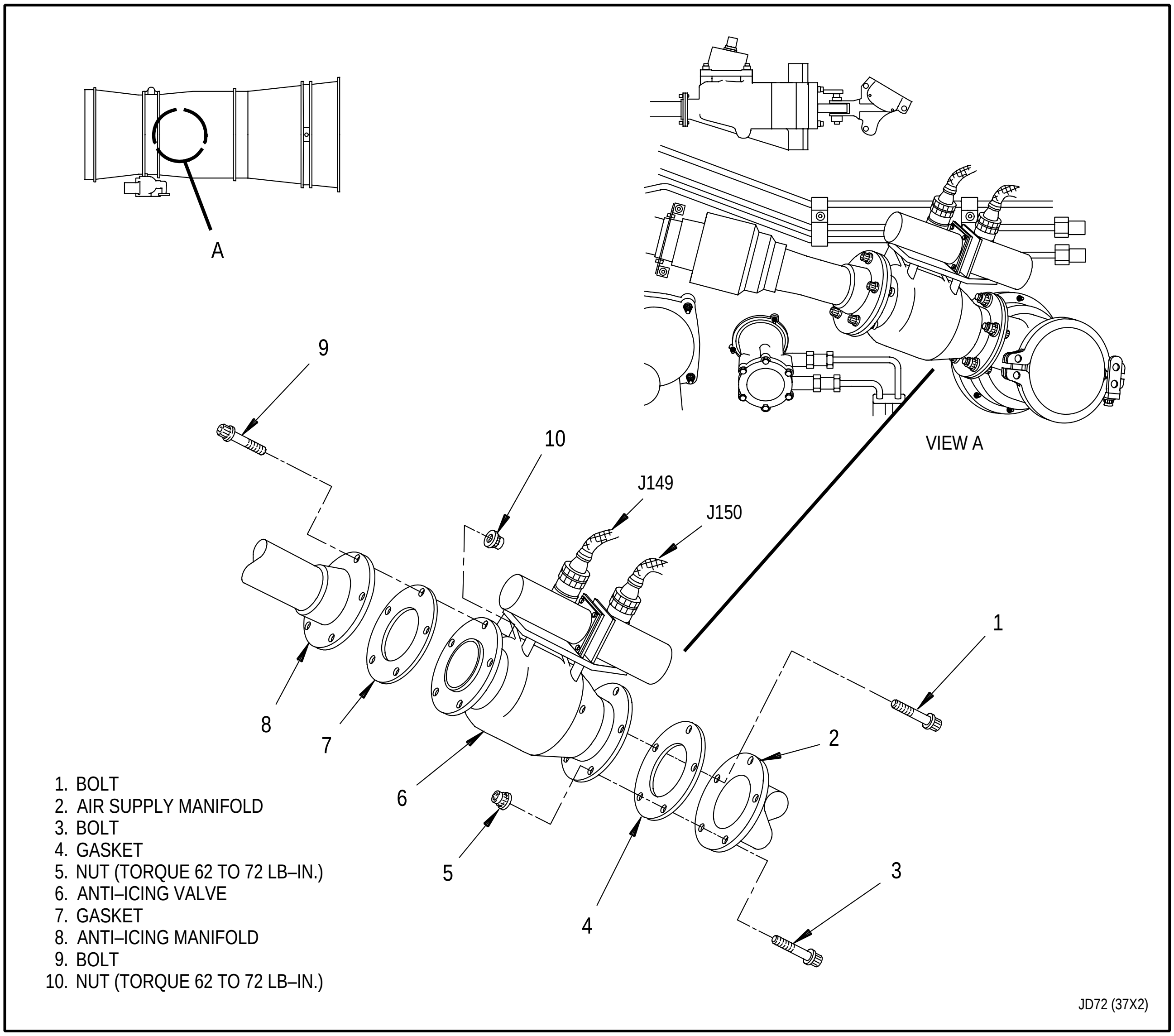


Figure 6. Engine Inlet Anti-icing Valve - Installation (Sheet 1 of 2)

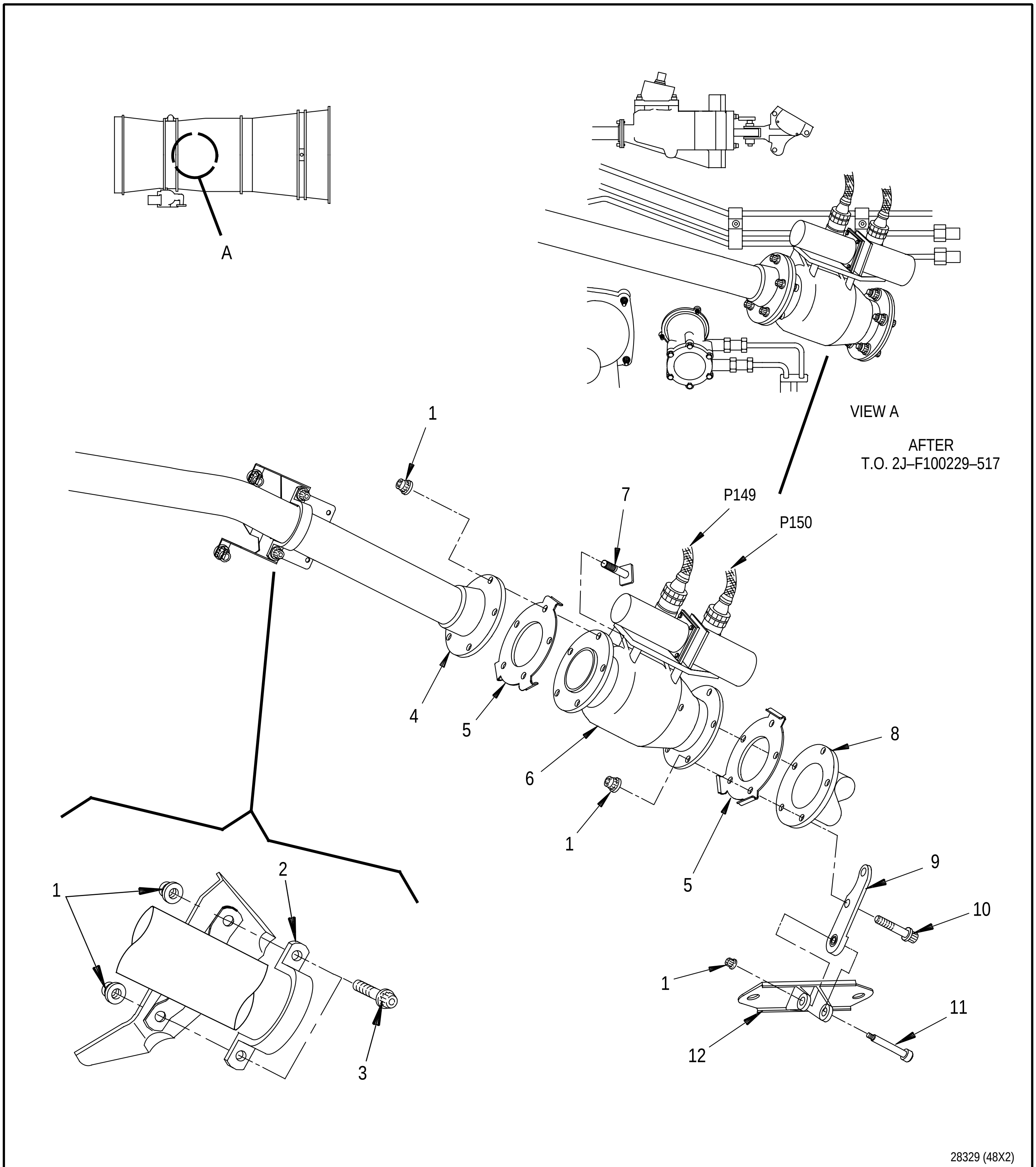


Figure 6. Engine Inlet Anti-icing Valve - Installation (Sheet 2 of 2)

(4) Position valve(6) on manifold(2) and install remaining four bolts(3).

(5) Install nuts(5) fingertight.

(6) Place gasket(7) on front mating flange of valve(6).

(7) Position manifold assembly(8) on valve(6) and install five bolts(9), bolt head forward, through manifold(8), gasket(7), and valve(6).

(8) Install nuts(10) fingertight.

CAUTION

Before torquing nuts, ensure anti-icing valve is properly aligned with mating flange and is not cocked.

(9) Torque nuts(5 and 10) 62 to 72 pound-inches.

CAUTION

Do not misalign connectors when mating connectors to receptacles as damage to receptacle inserts may occur.

(10) Align keyways and push connectors into receptacles while handtightening knurled ring one full turn (360 degrees).

(11) Ensure tightness by verifying red line on receptacles is covered by connector.

k. Remove throttle shaft from throttle gearbox and engine main fuel control power lever shaft.

l. Remove bellmouth assembly/ bellmouth extension assembly from engine inlet.

m. Remove quick-release pin positioning anti-chuck arm to test cell adapter.

n. Remove quick-release pin securing anti-chuck arm rod end to engine mount EM3.

o. Disconnect DEEC/EDU cooling lines from engine quick-disconnect couplings located near main fuel pump filter.

p. Disconnect fuel supply line from main fuel pump coupling. (See figure 7.)

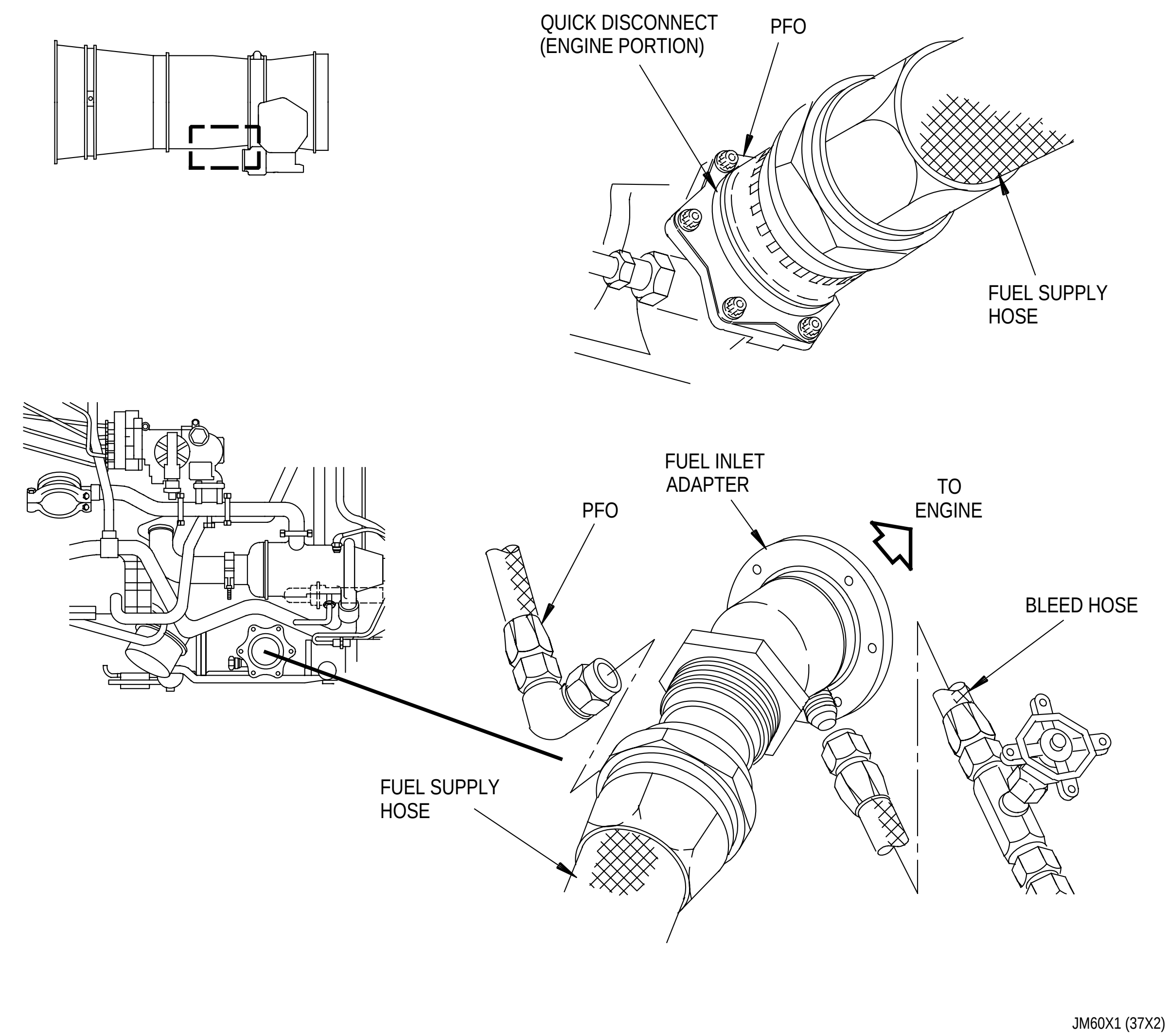


Figure 7. Fuel Supply and Bleed Hoses - Removal

q. Disconnect adapter assemblies of overboard drain adapters from engine fuel drains OD1 and OD2.

r. Disconnect P119A connector from J119 receptacle of generator stator and J119A connector from P119 connector of engine ignition cable. Connect P119 connector of engine ignition cable to J119 receptacle of generator stator.

s. Disconnect EMSE from DEEC and EDU as follows:

(1) Disconnect P146 connector from J146 engine receptacle.

(2) Disconnect P22 connector from J3 receptacle on EDU.

(3) Disconnect P21 connector from J2 receptacle on EDU.

(4) Disconnect P20 connector from J1 receptacle on EDU.

t. Disconnect MOT cable from the receptacle on MOT/POPD probe. (See figure 8.)

u. Disconnect POPD hose from MOT/POPD probe.

v. Remove P_b and P_{t6} hoses from engine. Install caps on customer service ports, torque 90 to 100 pound-inches and lockwire using PN MS9226-04 wire.

w. Remove MOT/POPD probe from engine. Install plug on main oil pump discharge pressure manifold boss, torque 200 to 225 pound-inches and lockwire using PN MS9226-04 wire.

x. Remove Pmb hose from engine. Install cap to Pmb tap, torque 90 to 100 pound-inches and lockwire using PN MS9226-04 wire.

y. If applicable, disconnect cable between each accelerometer (VICV, VGBV, VDCH and VAP6) and vibration channel on the connector panel.

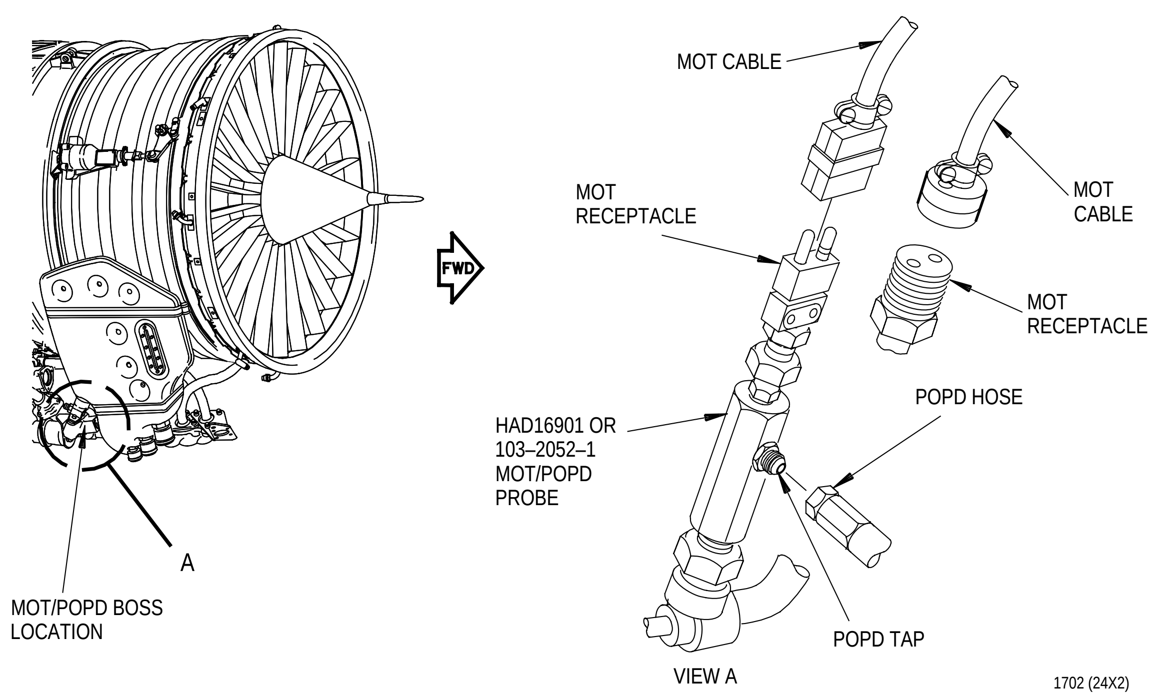


Figure 8. MOT/POPD Probe Hose and Cable - Removal

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE TRANSFER FROM AF 8624150 TEST CELL ADAPTER TO SHIPPING SUPPORT ON ALC 3000E TRANSPORTATION TRAILER

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 24

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	5	5	5	11	0
2	0	6 - 9	0	12 - 16	5
3	5	10	5	17 - 23	0
4	0			24 Blank	0

REFERENCE MATERIAL REQUIRED

Title	Number
Engine ----------------------------------	T.O. 2J-F100-53-5
Engine Packing ----------------------------	WP 043 00
ALC 3000E Transportation Trailer ------------------	T.O. 35D33-26-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
Lockwire (0.040 inch diameter)	MS9226-05

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Engine Transfer From AF 8624150 Test Cell Adapter to Transverse Supports On ALC 3000E Transportation Trailer	
	Adapter, Engine transfer rear	PWA 51920
	Adapter, Engine transfer front	PWA 51921
	Support - Transverse, engine transfer adapter	PWA 51415
	Trailer, Transportation adapter airlog rail to transverse (support trailer)	PWA 51417
3	Engine Transfer From Transverse Supports to Shipping Support	
	Trailer, Transportation	ALC 3000E
	Support, Engine shipping	P4006409
	Bumper Assembly, Engine	P4030580
	Following are also required if it is preferred to remove shipping support from trailer using hoist instead of empty transportation trailer	
	Sling, Engine handling	PWA 50301
	Adapter Sling, Engine handling rear	PWA 50336

ILLUSTRATED SUPPORT EQUIPMENT

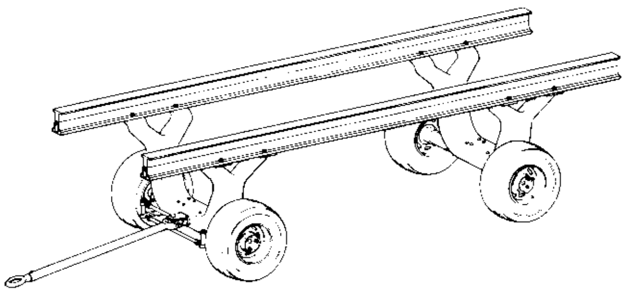


Figure T1. ALC 3000E Trailer

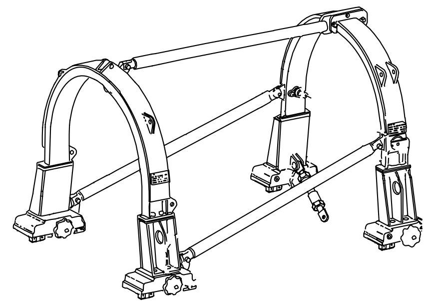


Figure T2. PN4006409 Support

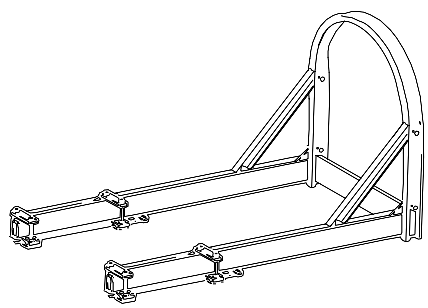


Figure T3. PN4030580 Bumper

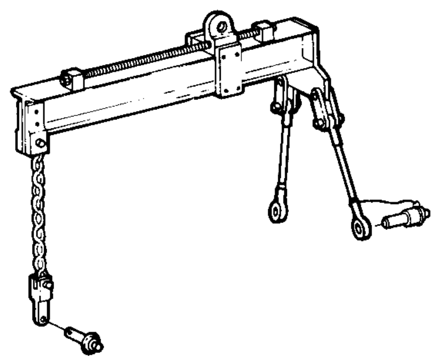


Figure T4. PWA 50301 Sling

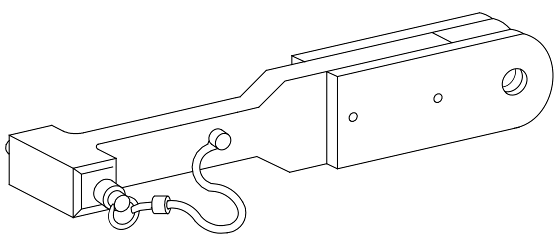


Figure T5. PWA 50336 Adapter

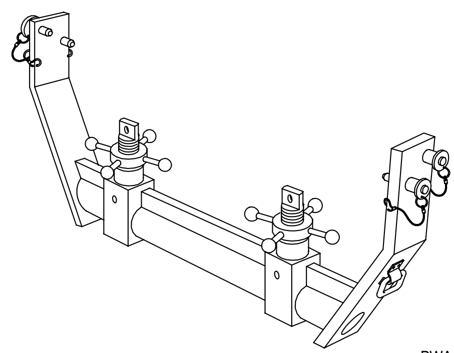


Figure T6. PWA 51415 Support

ILLUSTRATED SUPPORT EQUIPMENT

Figure T7. Deleted

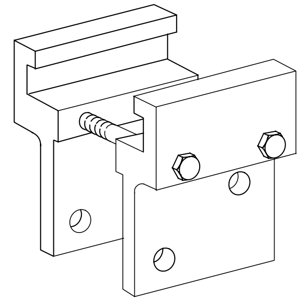


Figure T8. PWA 51417 Adapter

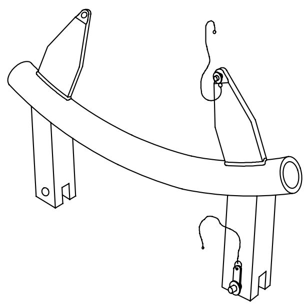


Figure T9. PWA 51920 Adapter

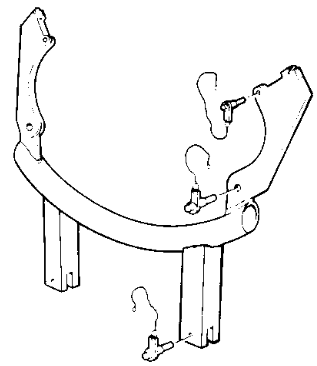


Figure T10. PWA 51921 Adapter

1. INTRODUCTION.

a. This work package contains instructions for transfer of engine from AF 8624150 engine test cell adapter to shipping support assembly on ALC 3000E transportation trailer. Transfer is made from test cell adapter to transverse supports; then from transverse supports to shipping support assembly on ALC 3000E trailer.

2. ENGINE TRANSFER FROM AF 8624150 TEST CELL ADAPTER TO TRANSVERSE SUPPORTS ON ALC 3000E TRANSPORTATION TRAILER.

(See Figures 1 through 8.)

a. Remove antichuck linkage as follows: (See figure 1.)

(1) Remove antichuck link by removing ball lock pins securing link to engine Flange H and J and antichuck arm.

(2) Remove antichuck arm by removing ball lock pins securing arm to test cell adapter.

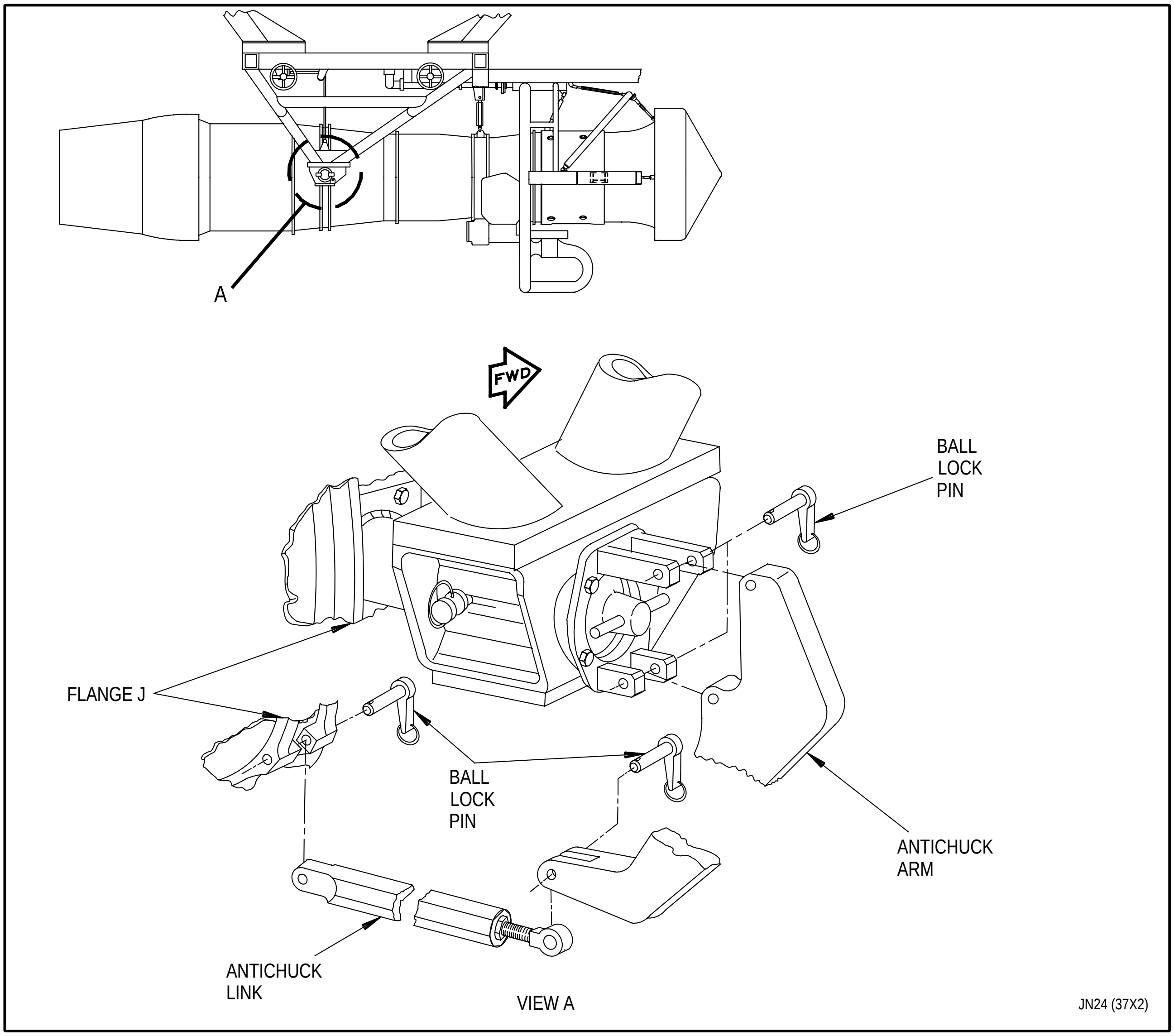


Figure 1. Antichuck Linkage - Removal

CAUTION

Install quick-release pins by hand only. Excessive force (hammering) will destroy locking feature of pins and could damage engine.

b. Inspect headless pin on right and left side of Flange F. If pin is missing or loose temporarily install a quick-release pin. (See figure 2.)

c. Install PWA 51921 adapter bracket details on Flange F at 4 and 8 o’clock positions. Secure with quick-release pins. (See Figure 2.)

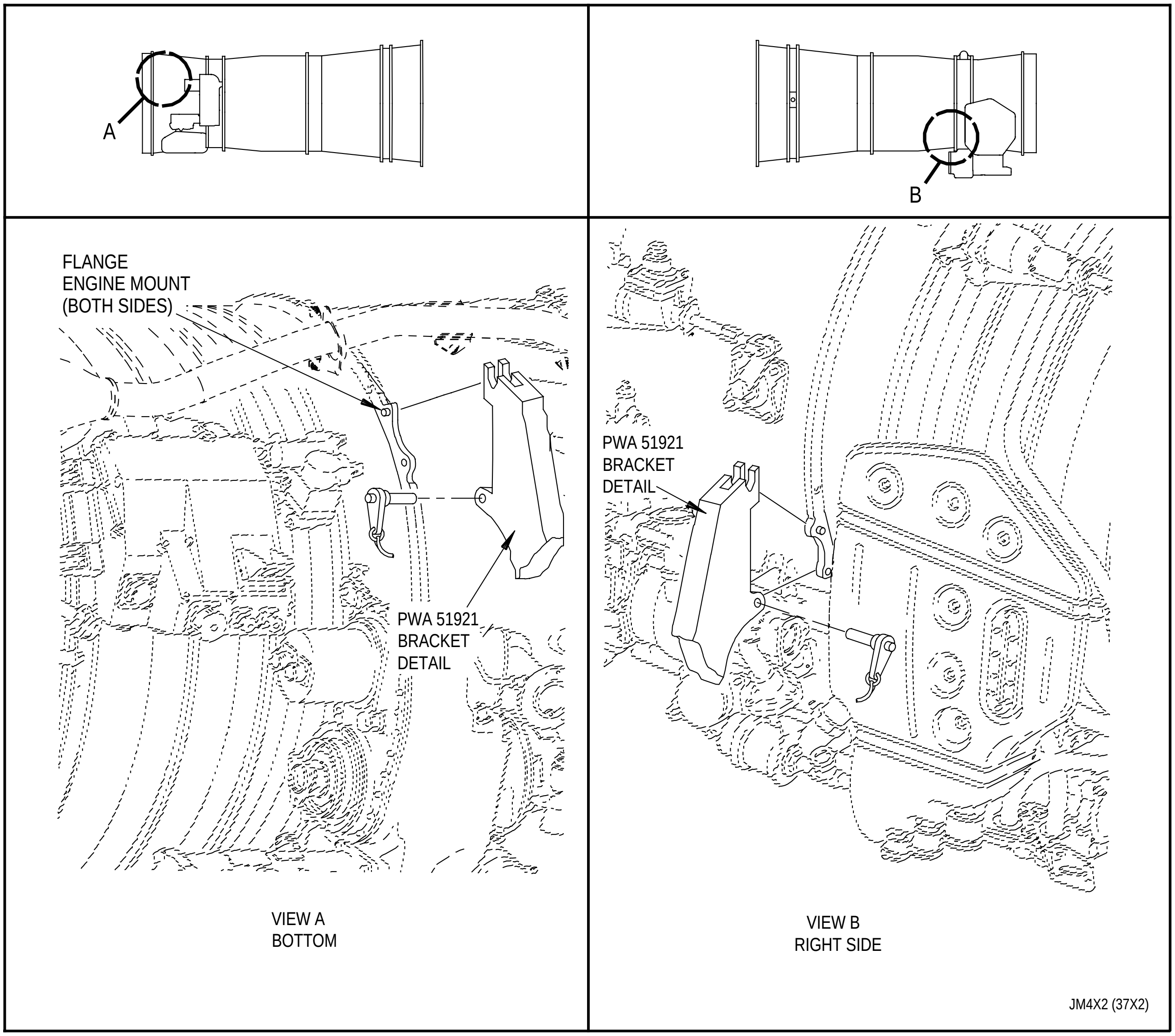


Figure 2. PWA 51921 Bracket Detail Installation on Engine Flange F

d. Install bracket details of PWA 51921 transfer adapter on Flanges F. Secure with quick-release pins. (See figure 3.)

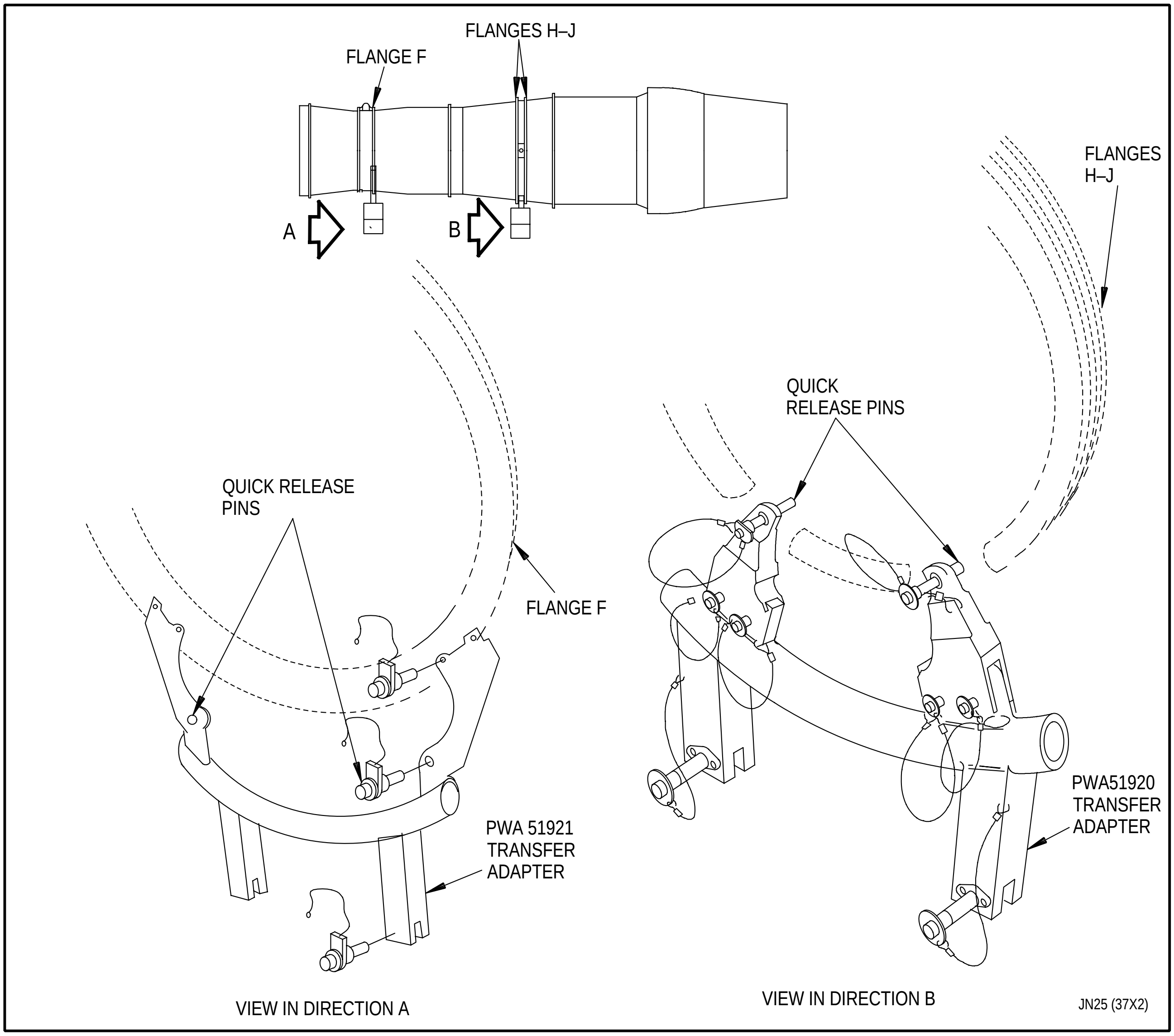


Figure 3. Installation of PWA 51920 and PWA 51921 Transfer Adapters on Engine

e. Install PWA 51920 rear transfer adapter as follows: (See figure 4.)

(1) Remove bracket details from adapter.

(2) Install brackets to ground handling mount on bottom right and left sides of Flanges H and J. Secure with quick-release pins.

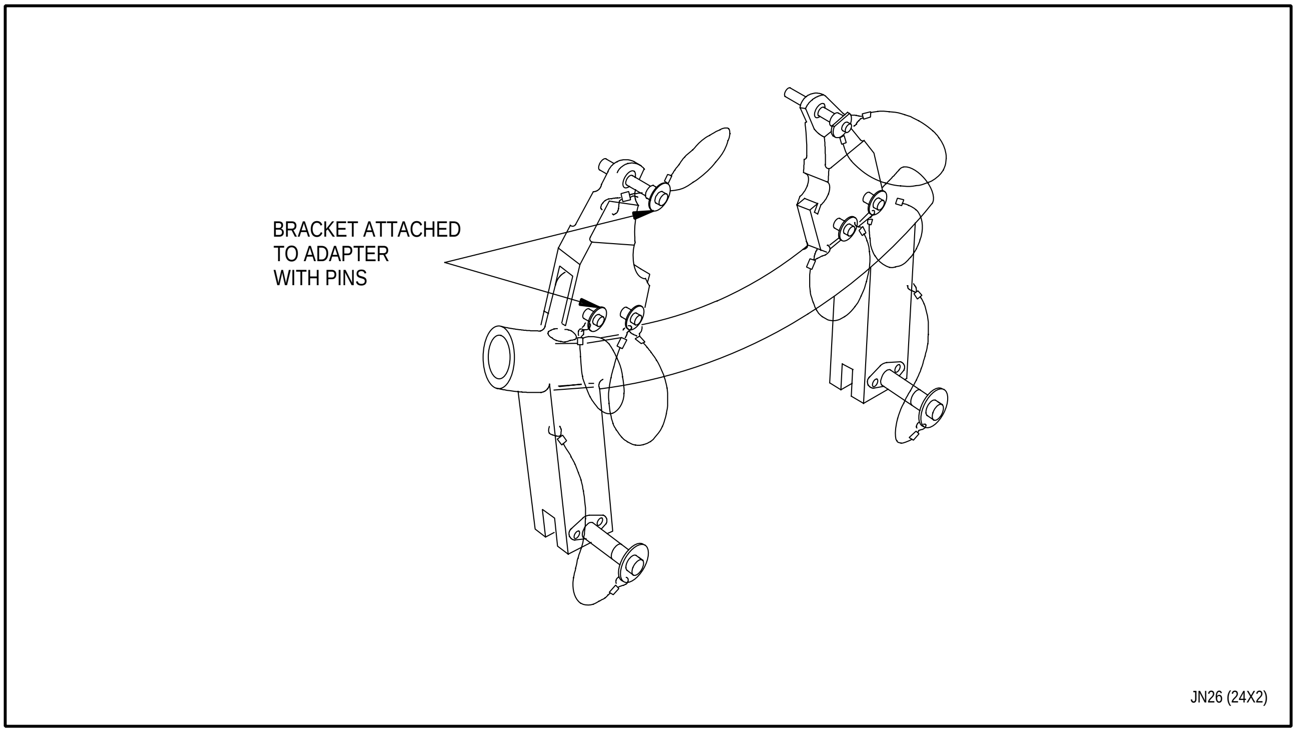


Figure 4. PWA 51920 Rear Transfer Adapter

f. Install four PWA 51417 adapters on lower tracks of transportation trailer rails. Position front adapters just behind trailer front axle. Do not tighten adapter bolts at this time. (See figure 5.)

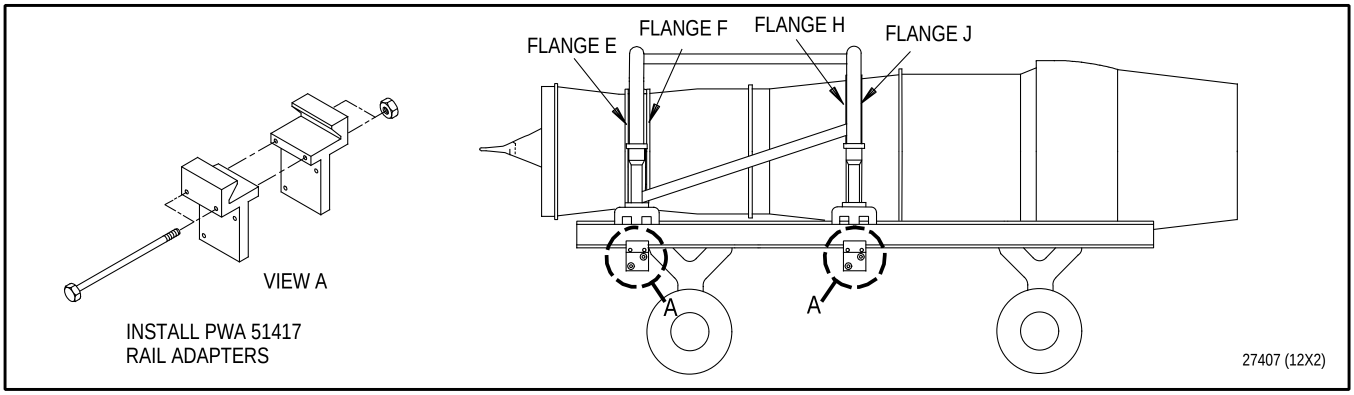


Figure 5. PWA 51417 Rail Adapters - Installation

g. Install PWA 51415 transverse supports to transfer adapters at forward and rear adapter locations on trailer. Secure supports to adapters using quick-release pins in adapters. (See figure 6.)

NOTE

Towing tongue shall be removed from trailer to provide adequate clearance when trailer is positioned for engine transfer.

h. Position trailer behind test cell adapter.

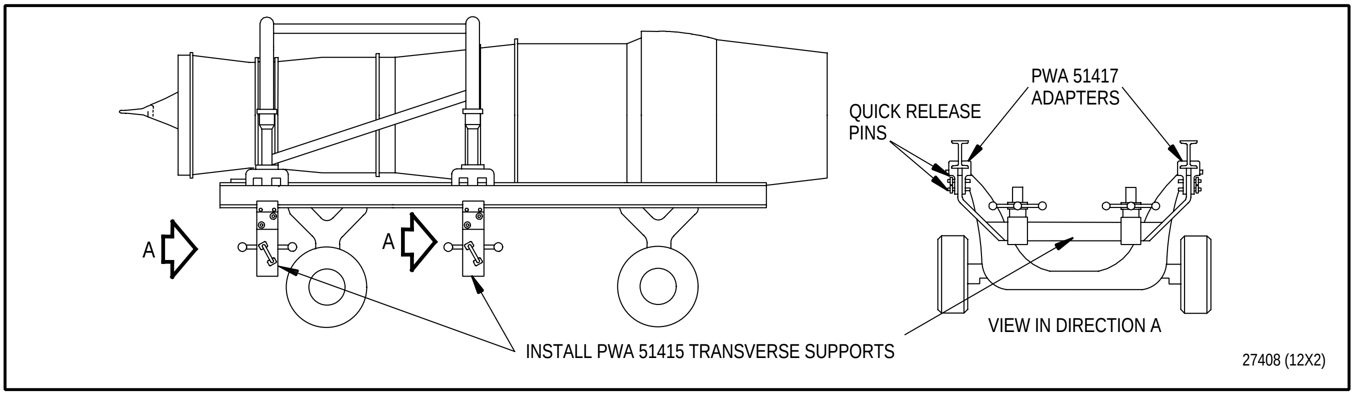


Figure 6. PWA 51415 Transverse Supports - Installation

CAUTION

Ensure adequate clearance is maintained between engine and transportation trailer to prevent engine damage.

i. Carefully position trailer with transfer adapters under engine installed in AF 8624150 adapter. Align jackposts in transverse supports on trailer with receptacles in PWA 51920 and PWA 51921 adapters installed on engine.

NOTE

Handle is located on right side adjacent to starter air inlet frame.

j. Disengage pinlock on top of bellmouth and starter gearbox support frame by lowering handle; then roll bellmouth assembly forward until forward lock can be engaged; then release handle up.

k. Disengage engine mounts at 3 and 9 o’clock positions on Flanges H and J as follows: (See figures 7 and 8.)

(1) Attach lifting sling detail to clevis at rear winch cable on adapter. Lower lifting sling using rear winch and secure to Flanges H and J using pins provided. Secure pins with safety pins.

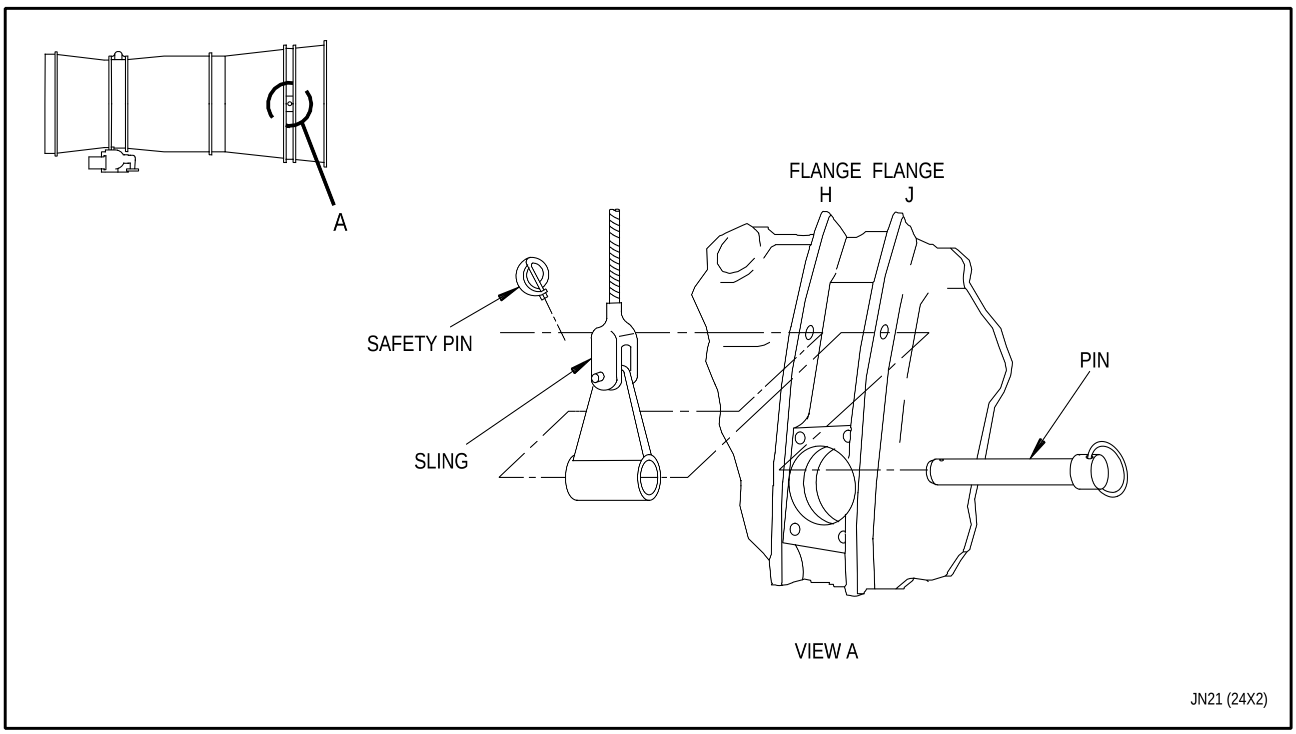


Figure 7. Installation of Lifting Sling at Flanges H and J (Typical Both Sides)

(2) Rotate rear winch handwheel to transfer engine weight from adapter thrust pins to lifting sling detail.

(3) Remove safety pins securing locking pins at adapter thrust pins. Remove locking pins and disengage thrust pins from engine mount receptacles.

l. Using front winch handwheel, support engine weight to allow removal of pin securing upper end of adapter front connecting link at Flanges E-F. Remove safety pin and remove quick-release pin securing link to adapter. (See figure 8.)

CAUTION

- Ensure receptacles on PWA 51920 and PWA 51921 transfer adapters are aligned with jackposts on transverse supports.
- Do not fully transfer engine weight until PWA 51417 rail adapters holding PWA 51415 transverse supports have been secured.

m. Using front and rear winch handwheels, slowly lower engine until receptacles on adapters and jackposts on transverse supports begin to mate.

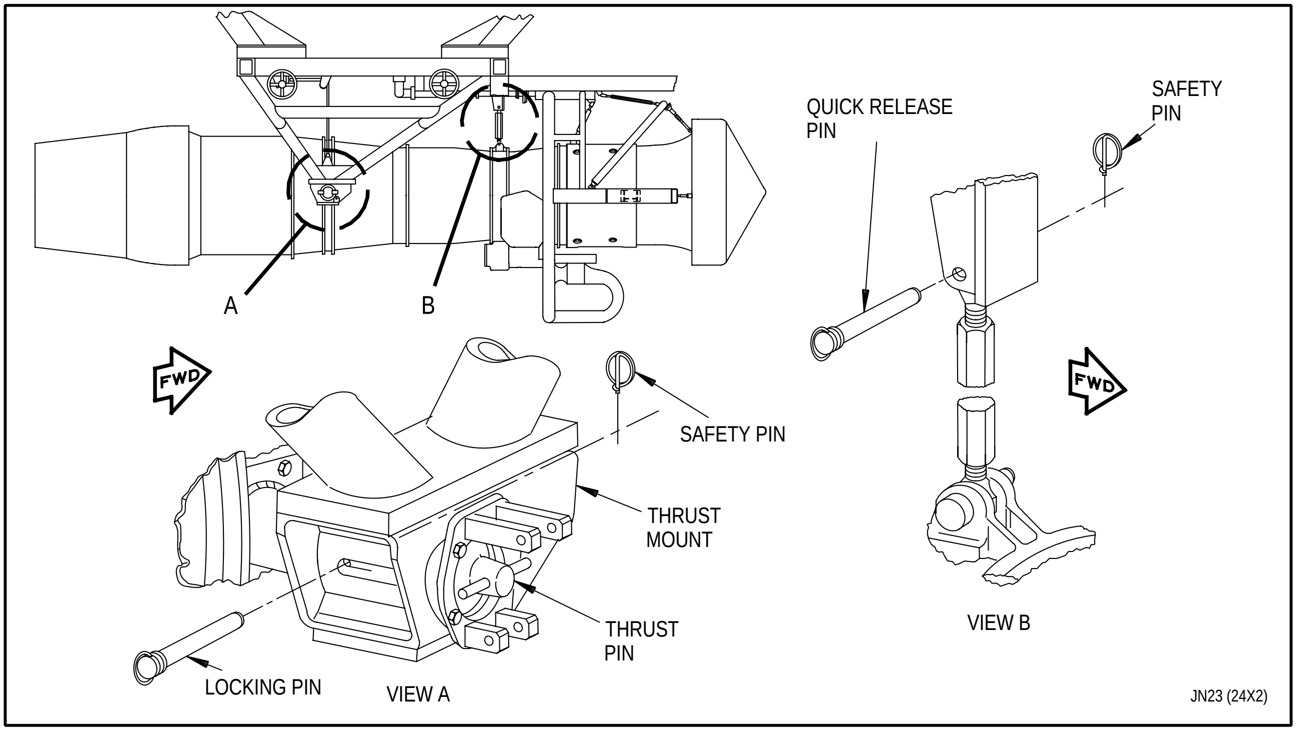


Figure 8. Disengagement of Engine From AF 8624150 Test Cell Adapter

WARNING

To prevent personnel injury, ensure detail bolts of PWA 51417 adapters are properly torqued.

n. Torque detail bolts of PWA 51417 adapters to 600 to 650 pound-inches. (See figure 5.)

o. Continue lowering engine until PWA 51920 and PWA 51921 transfer adapters can be pinned to jacks on PWA 51415 transverse supports.

p. Lower engine to fully transfer engine weight to transverse supports.

q. Remove safety clips and pins securing lifting sling detail to Flange H and J and remove sling from rear winch on test cell adapter frame.

r. Remove safety pins and pin securing adapter front connecting link at 12 o’clock position at Flanges E-F. Raise front of connecting link clear of engine using front winch handwheel.

CAUTION

To prevent engine damage,ensure adequate clearance exists between engine and adapter.

s. Raise AF 8624150 adapter out of position to clear engine and transportation trailer

3. ENGINE TRANSFER FROM TRANSVERSE SUPPORTS TO SHIPPING SUPPORT.
(See Figures 9 through 12.)

CAUTION

- Transverse supports are used to temporarily support engine during transfer to shipping support. Do not move or work on engine when supported solely by transverse supports and associated hardware.
- Install ball lock pins by hand only. Excessive force to install pins will destroy locking feature and could damage engine.

a. Shipping support may be installed on ALC 3000E trailer using either an overhead hoist or second trailer. If hoist is to be used to install support, go to step e.

b. Attach rear of second ALC 3000E transportation trailer with shipping support installed to front of trailer with engine installed on transverse supports.

CAUTION

Ensure front mount link clears engine.

c. Unlock shipping support rollers. Depress trailer stop pins and roll support aft until it is positioned over engine at Flanges E-F and H-J. Lock shipping support rollers. (See figures 9 and 12.)

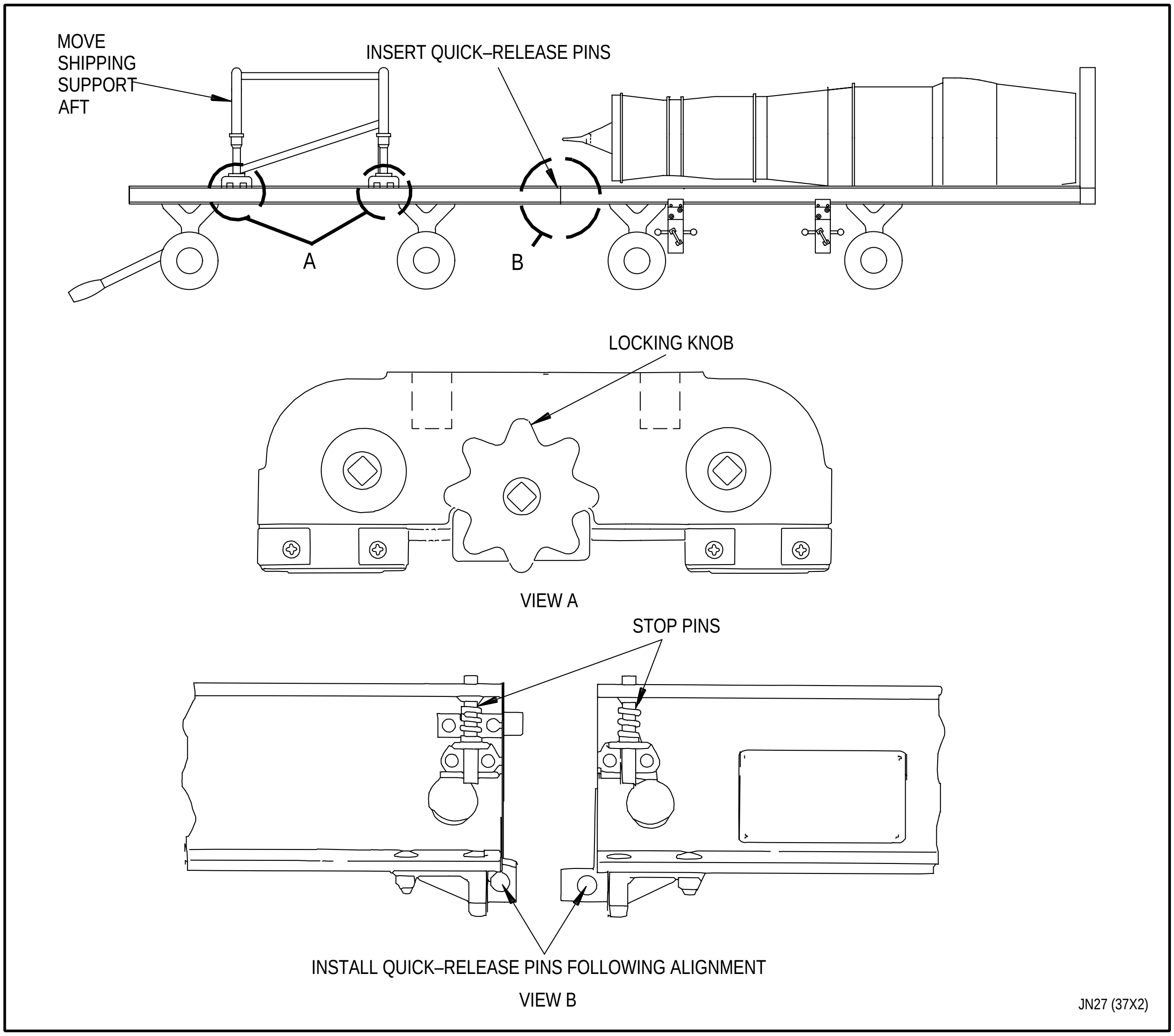


Figure 9. Transportation Trailers and Shipping Support - Installation

d. Disconnect and remove empty transportation trailer. Go to step f.

e. Install shipping support using overhead hoist as follows: (See figures 10 and 11.)

WARNING

To prevent personnel injury or engine damage, use only the quick-release pins at shipping support assembly locations specified in figure 11.

CAUTION

To prevent damage to quick-release pin self-locking mechanisms, do not hammer pins into place. After pin installation and lockwiring, ensure each pin is fully engaged to retain pin in place. Qualified personnel should inspect quick-release pins for proper installation.

NOTE

This procedure applies only for installation of shipping support to remove engine from test area.

(1) Remove clevis(5) from shipping support and secure to engine front mount lugs at Flanges E-F 12 o’clock position, with quick-release pin(3 or 14). If pin(14) is used, lockwire pin with PN MS9226-05 wire.

(2) Connect two PWA 50336 adapters to lugs on aft end of shipping support with pins.

(3) Position PWA 50301 sling over shipping support assembly using hoist.

(4) Connect PWA 50336 adapters to aft end of sling with pins.

(5) Connect front chain link of sling to lugs at front top center of shipping support.

(6) Using hoist, position shipping support assembly on ALC 3000E transportation trailer. Align front of shipping support with engine front mount (Flanges E-F).

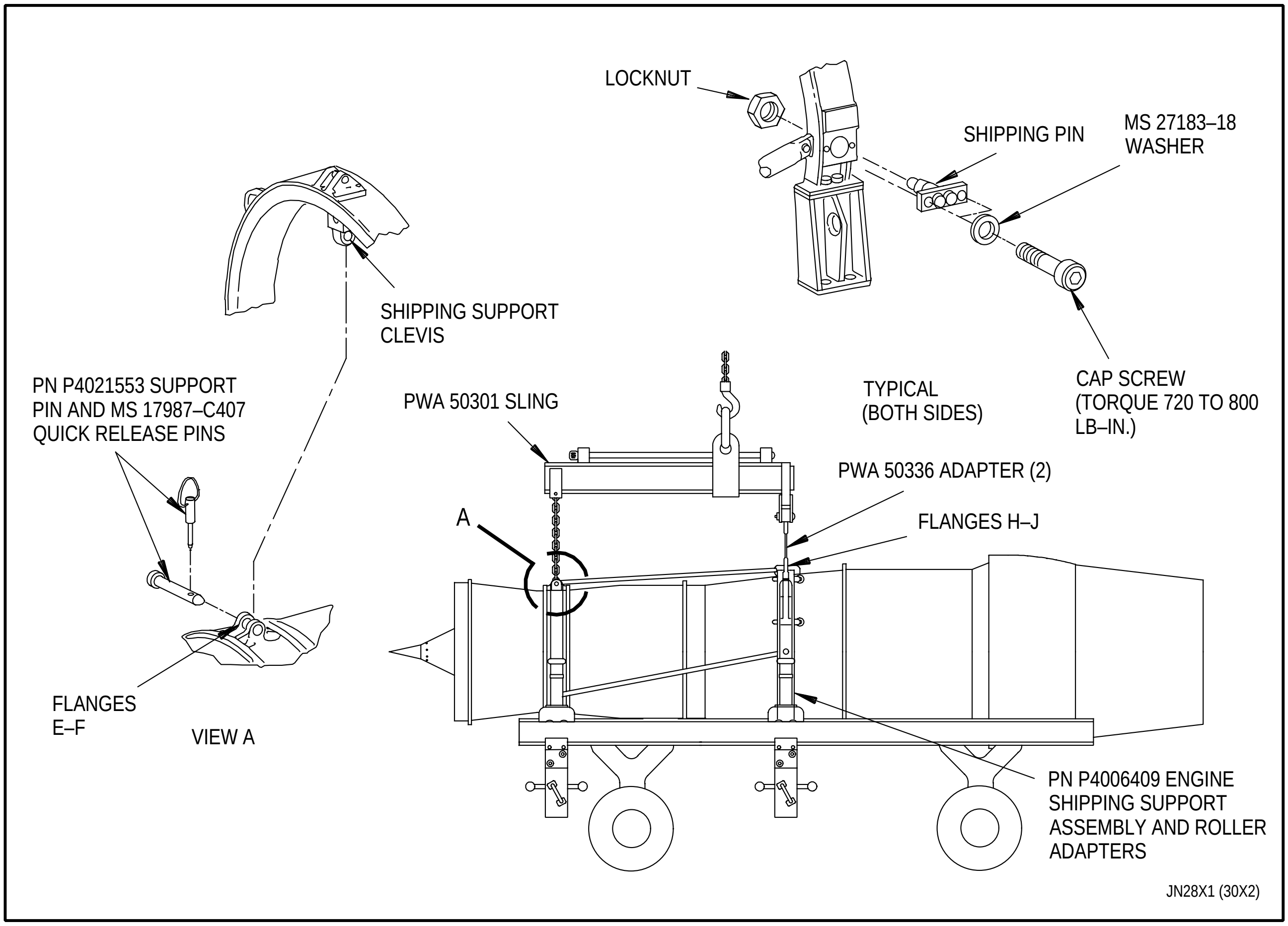


Figure 10. Shipping Support Assembly Installation on Transportation Trailer

f. Install shipping support to engine as follows: (see figure 11.)

(1) Adjust rear transverse support jackscrews as required to align engine rear mount holes (3 and 9 o'clock position) between Flanges H-J, with shipping support rear mount holes.

(2) Install shipping pins(8) in rear mount at 3 and 9 o'clock positions.

NOTE

To ensure proper projection of screw(9) is maintained, up to four washers(7) may be used under head of screw(9).

(3) If necessary install washers(7) under head of screw(9). Secure pin(8) to support with screw(9) and locknut(6).

(4) Use jacks on front transverse support to align shipping support clevis(5) with front shipping support. Secure clevis to shipping support using quick-release pin(1).

Legend for figure 11

1. PN P4021553 support pin
2. PN MS17987-C407 quick-release pin
3. Dual configuration pins. A set of one each of pins(1 and 2) is interchangeable with single pin(14).
4. PN 4006409 shipping support
5. Shipping support clevis
6. Locknut
7. PN MS2183-18 washers (as required)
8. Engine shipping pin and lockplate
9. Screw
10. PN 4006421 shipping turnbuckle
11. PN MS17986-C-833 quick-release pin
12. Front engine mount
13. PN 4021556 and P46601 roller adapter
14. PN 4045502 quick-release pin
15. PN MS9226-05 lockwire (double-twisted)
16. Pinlock balls
17. P4030580 bumper assembly

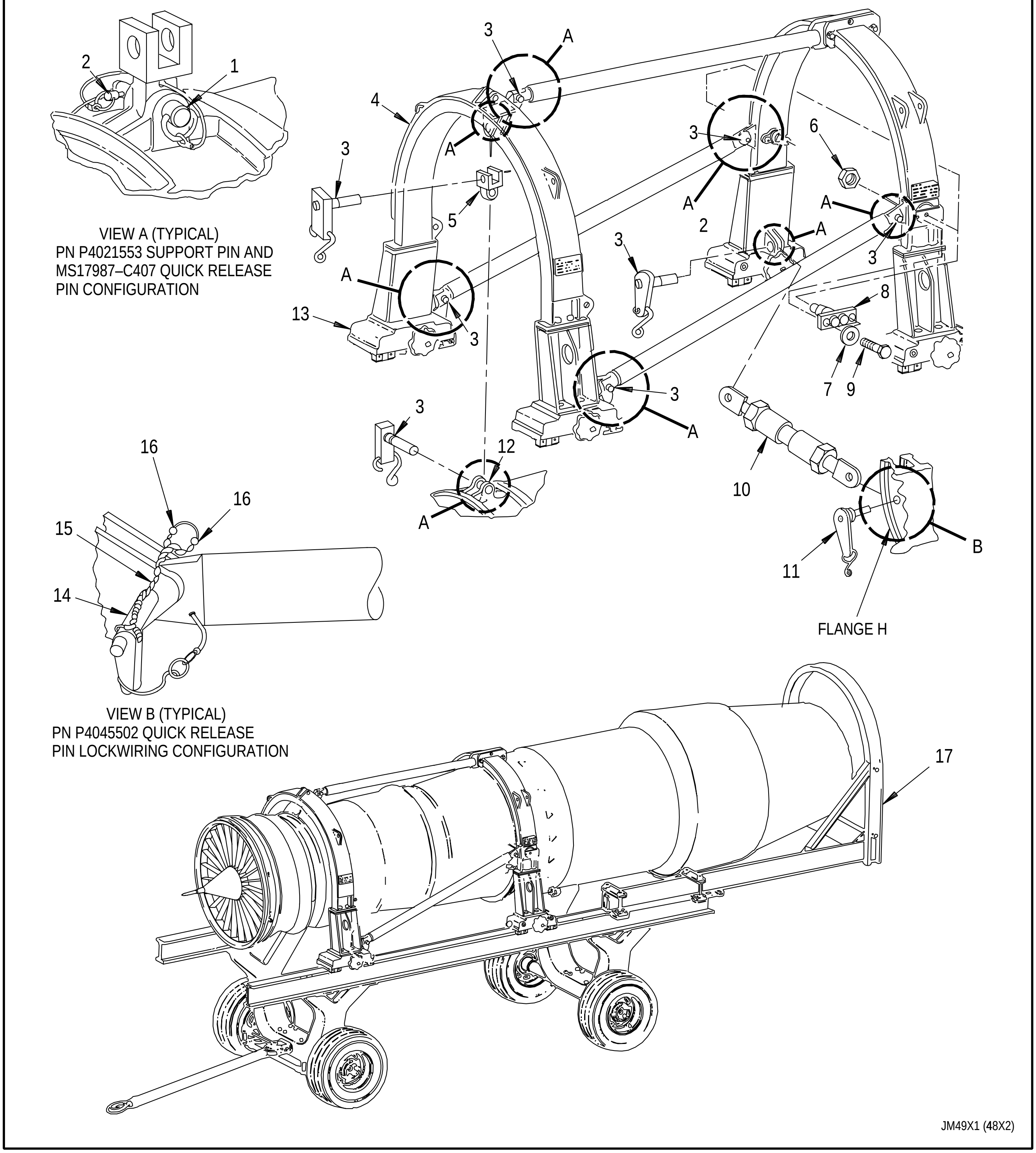


Figure 11. Engine Shipping Support Installation and Quick-Release Pins Lockwiring

CAUTION

- To prevent engine damage by improperly locked shipping support assembly roller adapters, inspect roller adapters for positive contact between locking jaws and underside of rail top flange after torquing brake knob. (See figure 12.) Any gap between locking jaw and rail flange is unacceptable.
- If gap inspection reveals unacceptable condition, ensure ALC 3000E trailer rail dimensions comply with T.O. 35D3-3-26-1. If trailer rail dimensions are acceptable, replace roller adapters.

(5) Lock shipping support roller adapters to trailer rails by inserting torque wrench in square hole in brake knob. Torque 375 to 400 pound-inches. (See figure 12.)

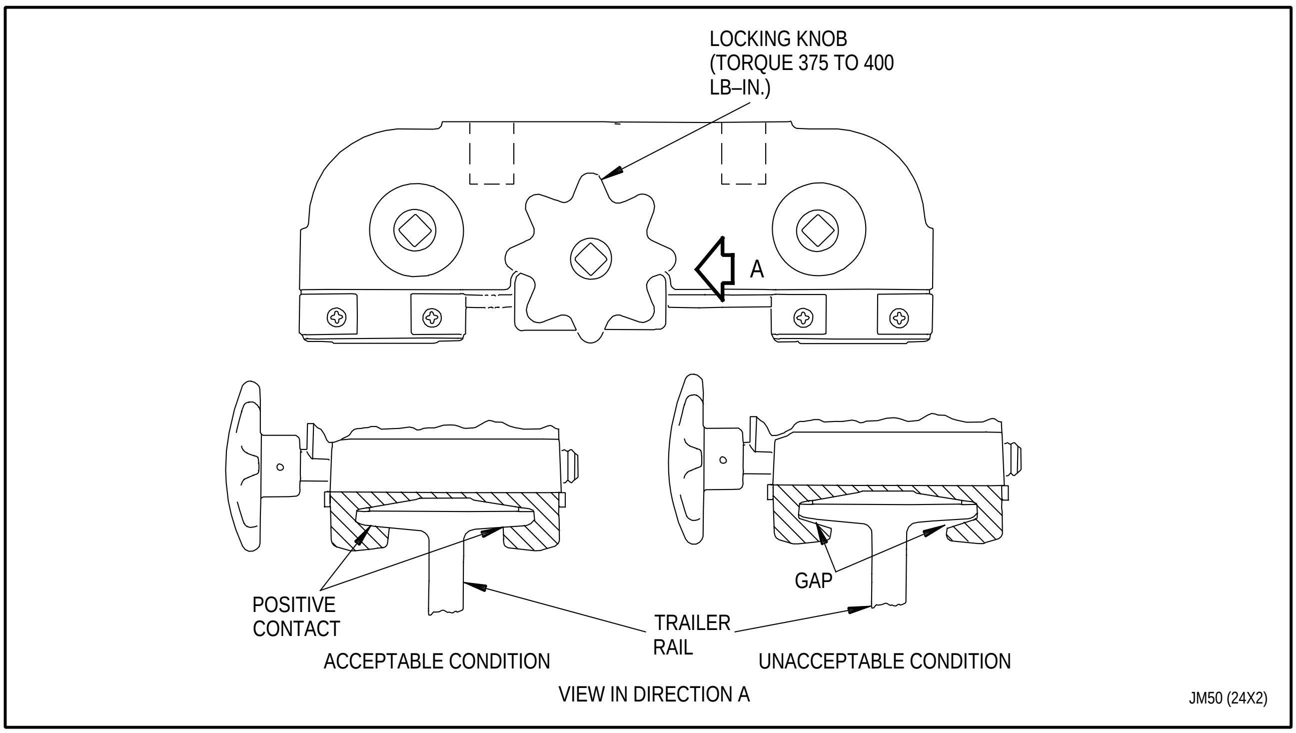


Figure 12. Inspection of Shipping Support Roller Adapters for Proper Locked Condition

(6) Transfer engine weight to shipping support by lowering jackscrews of transverse supports.

(7) Remove quick-release pins securing front transfer adapter to bracket details.

(8) Lower front jackscrews as necessary to remove front transfer adapter.

(9) Remove front transfer adapter.

(10) Remove front transverse support and front rail adapters.

(11) Remove quick-release pins securing bracket details to Flange F, then remove bracket details.

(12) Lower rear jackscrews and remove rear transverse support and rail adapters.

(13) Remove quick-release pin securing left side of rear transfer adapter.

(14) Remove quick-release pin securing right side of rear transfer adapter, then remove rear transfer adapter.

(15) Install shipping turnbuckle(10, figure 11) between rear right side of shipping support and lower right handling mount on engine Flanges H-J. Adjust length of turnbuckles until quick-release pins can be installed. Tighten turnbuckle locknuts.

NOTE

Use double-twisted lockwire.

(16) Where pins (14) are used instead of pins (3), lockwire all quick-release pins handles to adjacent shipping support details and around opposite end of pin using double-twisted PN MS9226-05 lockwire. See figure 11 for locations.

g. Install P4036503A 9992 augmentor cover around outer rear diameter of augmentor nozzle.

NOTE

Ensure end of augmentor is at least six inches away from bumper upright channel.

h. Install bumper on ALC 3000E transportation trailer. Secure bumper to trailer with clamps. Clamps should be installed as near bumper center and trailer overlap as possible.

i. Prepare engine for shipping. Refer to T.O. 2J-F100-53-5, WP 043 00.

WORK PACKAGE

INTRODUCTION

ENGINE TROUBLESHOOTING

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	28	4 - 5	23	7	23
2	0	6	28	8 Blank	0
3	27				

1. INTRODUCTION.

a. This work package introduces the WP 500 00 through 699 00 series of work packages for engine troubleshooting.

WP No.	Title
500 00	Engine Troubleshooting - Introduction
501 00	Engine Troubleshooting - General
502 00 through 503 00	Open
504 00	System Fault Light Illuminated
505 00	EMS Fault Light Illuminated
506 00	Engine Caution Light Illuminated
507 00	Secondary Caution Light Illuminated
508 00	Augmentor Mn Fault Light Illuminated
509 00	Start Anomaly - Primary Mode
510 00	Engine Instability - Primary Mode
511 00	Engine Anomaly, Idle to Intermediate (MIL) - Primary Mode
512 00	Augmentor Anomaly
513 00	Exhaust Nozzle Position Out of Limits - Primary Mode
514 00	Idle Speed Out of Limits
515 00	EPR vs N1C2 Out of Limits, Intermediate (MIL) - Primary Mode
516 00	Maximum Fuel Flow Exceeds Limits
517 00	Anti-ice System Malfunction
518 00	Ignition System Anomaly
519 00	DEEC Pressure Transducer Malfunction
520 00	Mn System Malfunction
521 00	Fault Reset Malfunction
522 00	Mode Select Malfunction
523 00	Secondary Mode Anomaly

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE TROUBLESHOOTING - GENERAL

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 24

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	28	9 - 14	0	19	28
2	18	15 - 16	23	20	23
3 - 6	0	17	17	21 - 23	0
7 - 8	23	18	23	24	28

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00
Engine Acceptance Test	WP 212 00
Oil System Contamination	WP 304 00
Engine Fuel System Contamination	WP 305 00
System Fault Light Illuminated	WP 504 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
Operation Instructions For Jet Engine Analyzer Unit EAU-15/E	T.O. 33D4-6-684-1
Data Collection Unit - Operation Instructions (This unit is designated as a data analysis control in referenced technical manual.)	T.O. 33D4-6-686-1

(See Tables 3, 4, and 5 for additional reference material)

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T.O. No.	Date	Level	Title (ECP No.)
T.O. 5E1-2-15-507	15 Jun 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
Alcohol, denatured	O-E-760, Type III
Degreaser, Freon TF	MIL-C-81302, Type II-A

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains general troubleshooting information.

2. GENERAL.

(See Tables 1 through 6.)

a. See table 1 for troubleshooting terms, definitions, and indications. See table 2 for abbreviations used in troubleshooting procedures.

b. See table 3 for references for maintenance action required.

c. Most engine anomalies (see table 4) are caused by one or more events or faults. These events, faults, or advisories, detected by the DEEC, EDU, or Ground Station Unit (GSU) appear on the EAU and DCU display or GSU (after download) as 4-digit code numbers (see table 5). These code numbers are directly related to troubleshooting procedures designed to correct the event, fault, or advisory. For standard troubleshooting procedures, see table 6.

CAUTION

While performing engine checks which involve monitoring RCVV positions, make sure that engine is not operating in axial flutter region because engine damage may result. Reject engine if engine operates for longer than two seconds in this region.

d. Prior to test stand run, check the following:

(1) Check for loose electrical connectors or tube connections. If electrical connector is loose, check connector for fuel, oil, or dirt contamination. Clean connector pins, sockets, and insulation with alcohol (O-E-760, Type III) or Freon degreaser (MIL-C-81302, Type II-A). Dry with clean compressed air. If tube connection is loose, retorque and lockwire as required.

(2) Check for failure flags on oil filter, main fuel pump interstage filter, and main fuel filter. If fuel filter flag is popped, perform fuel system contamination inspection per WP 305 00. If oil filter flag is popped, perform oil system contamination inspection per WP 304 00. Check engine Joint Oil Analysis Program (JOAP) records for adverse trends.

(3) Inspect engine inlet and exhaust for foreign object damage. Perform engine rotation inspection to ensure both rotors rotate freely. If damage is evident or both rotors do not rotate freely, borescope inspect through all ports.

(4) If a nonrecoverable stall has occurred, borescope inspect through AP 2, AP 3, AP 4 and AP 5 ports.

(5) Check recent engine history. If engine problem is a repeat, review previously performed troubleshooting.

(6) Inspect oil system chip detectors (No. 1, Nos.2 and 3, No. 4 and No. 5 bearing compartments). If contamination is found, perform oil system contamination inspection per T.O. 2J-F100-11-2, WP 304 00. Check engine JOAP records for adverse trends.

(7) Make sure components have compatible part numbers.

NOTE

Data not cleared from DEEC or EDU may be misinterpreted as repeating faults, events, or advisories.

(8) Check that EDU data has been reviewed and stored per WP 651 00; then clear EDU data per WP 656 00.

e. Refer to T.O. 33D4-6-684-1 for description and operating instructions for EAU.

f. Refer to T.O. 33D4-6-686-1 for description and operating instructions for DCU.

g. While running engine during troubleshooting, make sure that operating limits specified in WP 205 00 are not exceeded.

Table 1. Troubleshooting Terms, Definitions, and Indications

Troubleshooting Term	Definition	Indication
Augmentor Blowout	Sudden termination of the combustion process in the augmentor due to some form of augmentor instability (for example rumble or fan stall).	Exhaust nozzle closure. Augmentor blowout may cause fan stalls (bangs, pops).
Augmentor No-Light	Throttle is advanced and fuel flow and ENP increase in anticipation but no light-off occurs.	No thrust increase. Fuel flow and ENP cycle with LOD recycles.
Flameout/Dieout	Sudden termination of combustion process in the main engine combustor due to loss of fuel flow rate.	Decrease in N1, N2, and FTIT and, at Intermediate (MIL) or above, an increase in Aj.
No Start	Engine does not advance to IDLE during start attempt.	N2 and FTIT remain at below IDLE rpm.
Hung Start	Start attempt which results in slow or no acceleration with no overtemperature.	Slow or no increase in N2 with FTIT within starting limits.
Hot Start	Start attempt which results in slow or no acceleration with rapid increase in FTIT.	FTIT rising through 1472°F (800°C) while engine below IDLE rpm.
Start/Stall	Engine stall after normal acceleration to N2 rpm, usually accompanied by rapid increase in FTIT.	N2 accelerates normally then decreases while FTIT increases.

Table 1. Troubleshooting Terms, Definitions, And Indications (continued)

Troubleshooting Term	Definition	Indication
NOTE The terms surge and stall are normally used somewhat interchangeably. Since special instrumentation is not available on production aircraft/test stands, neither pilot nor ground personnel can usually discern whether a fan or core stall has occurred. However, a fan stall is usually associated with initiation or operation of the augmentor, while a core stall is usually associated with an IDLE, part-power, or Intermediate (MIL) anomaly. A stall is also classified by engine reaction as recoverable or non-recoverable.		
Fan Stall	A fan stall is generally considered a flow instability in the fan (for example, reverse flow) which may or may not disrupt the entire compression system.	A drop in N1, Aj opening and a possible rise in FTIT or drop in N2.
Core Stall	Considered to be a flow instability in the high compressor (due to a fan stall or high distortion) which affects the entire compression system.	An increase in FTIT, a decrease in N1 and N2, and Aj opening.
Recoverable Stall	The engine airflow instability clears itself.	Audible bang or engine hesitation.
Non-recoverable Stall	The flow instability cannot be cleared by an action of engine operator short of retarding PLA to cutoff to prevent engine overtemperature.	A rapid increase in FTIT, a decrease in N1 and N2, and Aj opening.
RCVV Flutter	1.RCVVs are misscheduled sufficiently to cause improper aerodynamic loading. This can lead to compressor blade fatigue. 2.Compressor blades are buffeted due to an inoperative variable vane. This causes compressor blade fatigue.	Potential audible bang. Increase in Idle N2 rpm or decrease in part power N2 rpm.

Table 2. Abbreviations Used In Troubleshooting Procedures

Abbreviation	Definition
A/B -	Augmentor
AFC -	Augmentor Fuel Control
AFP -	Augmentor Fuel Pump
AFPC -	Augmentor Fuel Pump Controller
Aj -	Augmentor nozzle throat area
AP -	Borescope inspection ports, AP1 through AP7
ASEP -	Augmentor Signature Elimination Probe (augmentor fuel dump nozzle and probe assembly)
AUG -	Augmentor
BPV -	Breather Pressurizing Valve
BX -	Bendix Energy Controls Division
CENC -	Convergent Exhaust Nozzle Control
CIVV -	Compressor Inlet Variable Vanes
CORR -	Measured engine parameters corrected to Standard Day Value
DCU -	Data Collection Unit
DEEC -	Digital Electronic Engine Control
EAU -	Engine Analyzer Unit
EDU -	Engine Diagnostic Unit
EETP -	Engine Electrical Terminal Panel
EFH -	Engine Flight Hours
EHV -	Electro-hydraulic valve
EMS -	Engine Monitoring System
EMSE -	Engine Monitoring Support Equipment
ENP -	Exhaust Nozzle Position
EOT -	Engine Operating Time
EPR -	Engine Pressure Ratio - Pt6m/Pt2
FTIT -	Fan Turbine Inlet Temperature (Tt4.5)
FWD -	Forward
GG -	Gas Generator (core engine)
GSU -	Ground Station Unit
GT -	Greater than
GIT -	Ground Idle Thrust
HSD -	Hamilton Standard Division
HST -	Hot Section Time
Hz -	Hertz (cycles per second)
IAR -	Idle Area Reset
IGN -	Ignition
in. Hg -	Inches of mercury
in. HgA -	Inches of mercury, absolute
Intermediate (Mil) -	Intermediate power (Military)
Intermediate -	Intermediate power (Military)
ISTS -	Ignition System Test Set
JOAP -	Joint Oil Analysis Program

Table 2. Abbreviations Used In Troubleshooting Procedures (continued)

Abbreviation	Definition
LCF -	Low Cycle Fatigue
LOD -	Light-Off Detector, Augmentor
LT -	Less than
MFC -	Main Fuel Control
MFP -	Main Fuel Pump
MAX AUG -	Maximum augmentation; engine power lever in 130 degrees position (Segment 11)
MIN AUG -	Minimum augmentation; engine power lever in 91 degrees position (Segment 1)
Mn -	Mach number
MOH -	Maximum Operating Hours
MOP -	Main Oil Pressure
MOPT -	Main Oil Pressure Transmitter
MOT -	Main Oil Temperature
M/V -	Metering Valve
N1 -	Front compressor rpm
N1C2 -	N1 corrected to Tt2
N2 -	Rear compressor rpm
N2C2 -	N2 corrected to Tt2
N2C2.5 -	N2 corrected to Tt2.5
P&D -	Pressurizing and Dump Valve
Pab -	Augmentor duct pressure
Pamb -	Ambient pressure
Pb -	Burner pressure
PF -	Fuel pressure
Pfo -	Fuel pump inlet pressure
PLA -	Power lever angle; MFC power lever shaft
Pmb -	Main breather pressure
Popd -	Oil pump discharge pressure
pph -	Pounds per hour
PRIM -	Primary (engine control)
Ps -	Static pressure
Ps2 -	Static pressure at fan inlet
Pscv-4 -	No. 4 bearing scavenge oil pressure
psid -	Pounds per square inch differential
DPscreen -	Screen loss pressure (DPscreen = Pcell - Pt2)
Pt -	Total pressure
Pt2 -	Total pressure at fan inlet
Pt2C -	Total pressure at fan inlet (DEEC calculated)
Pt2.5 -	Total pressure at rear compressor inlet
Pt3 -	Total pressure at rear compressor exit
Pt4 -	Total pressure at combustor exit
Pt4.5 -	Total pressure at fan turbine inlet
Pt5 -	Total pressure at fan turbine exit

Table 2. Abbreviations Used In Troubleshooting Procedures (continued)

Abbreviation	Definition
Pt6 -	Total pressure at turbine discharge
Pt6m -	Fan turbine discharge air pressure (core engine and fan bypass air mixed)
RCVV -	Rear compressor variable vanes
RED -	Resolver equivalent degrees
rpm -	Revolutions per minute
SEC -	Secondary engine control
SIP -	Starter inlet pressure
SN -	Serial number
SP GR -	Specific gravity
SVP -	Sequencing valve position
TAI -	Anti-ice air temperature
Tscv4 -	No. 4 bearing scavenge oil temperature
Tf -	Fuel temperature
Tf(FM) -	Fuel temperature at flowmeter
Tt -	Total temperature
Tt2 -	Total temperature at fan inlet
Tt2.5 -	Total temperature at fan discharge
Tt3 -	Total temperature at rear compressor exit
Tt4 -	Total temperature at combustor exit
Tt4.5 -	Fan turbine inlet temperature (FTIT)
Tt5 -	Total temperature at fan turbine exit
Tt6 -	Total temperature at turbine discharge
UART -	Universal Asynchronous (Digital) Receiver/Transmitter
VDCH -	Diffuser case vibration
VGBV -	Gearbox vibration
VICV -	Fan inlet case vibration
Wf -	Fuel flow
WFAC -	Augmentor core fuel flow
WFAD -	Augmentor duct fuel flow
WFC2 -	Corrected fuel flow
WFGG -	Gas generator fuel flow, pph
WFTOT -	Total fuel flow, pph
δt2 -	Pressure correction factor
θt -	Temperature correction factor

Table 3. References For Maintenance Action Required

Maintenance Item	Reference	
Anti-icing valve - removal/installation	T.O. 2J-F100-53-4,	WP 039 00
Augmentor duct and nozzle module - inspection	T.O. 2J-F100-53-10,	WP 300 00
Augmentor flameholder - inspection	T.O. 2J-F100-53-5,	WP 422 00
	TDP F100-6	Para. 5-40
Augmentor fuel control - removal/installation/leak check	T.O. 2J-F100-53-4,	WP 010 00
Augmentor fuel control module -	T.O. 2J-F100-53-4,	WP 011 00
Fill switch assembly replacement		
Segment sequencing valve EHV replacement		
Duct metering valve EHV replacement		
Core metering valve EHV replacement		
Sequencing valve resolver and cover assembly replacement		
Augmentor fuel pump controller - removal/installation	T.O. 2J-F100-53-4,	WP 012 00
Augmentor fuel pump - removal/installation	T.O. 2J-F100-53-4,	WP 013 00
Augmentor igniter plug - removal/installation	T.O. 2J-F100-53-4,	WP 025 00
Augmentor spray manifolds - removal/installation	T.O. 2J-F100-53-5,	WP 203 00 WP 603 00
Augmentor fuel pump nozzle and probe - removal/installation	T.O. 2J-F100-53-4,	WP 022 00
Breather pressurizing valve - removal/installation	T.O. 2J-F100-53-4,	WP 027 00
Borescope inspection (general instructions)	T.O. 2J-F100-53-5,	WP 020 00
Borescope inspection - equipment and operation	T.O. 2J-F100-53-5,	WP 021 00
	TDP F100-6,	Para. 5-4
CENC - removal/installation/leak check	T.O. 2J-F100-53-4,	WP 044 00
CENC module - CENC EHV replacement	T.O. 2J-F100-53-4,	WP 044 00

Table 3. References For Maintenance Action Required (continued)

Maintenance Item	Reference	
Chip detectors - removal/installation	T.O. 2J-F100-53-4,	WP 033 00
CIVV control and cylinder -	T.O. 2J-F100-53-4,	WP 036 00
removal/installation/rigging	T.O. 2J-F100-53-6,	WP 705 00
CIVV EHV replacement	T.O. 2J-F100-53-4,	WP 036 00
CIVV linear actuating cylinder - removal/installation	T.O. 2J-F100-53-4,	WP 037 00
Compressor bleed actuating cylinder - removal/installation	T.O. 2J-F100-53-4,	WP 038 00
Compressor stator linkage arm - removal/installation	T.O. 2J-F100-53-7, TDP F100-6,	WP 014 00 Para. 5-28
	T.O. 2J-F100-53-7,	WP 701 00
	TDP F100-6,	Para. 5-48
Convergent nozzle - integrity check	T.O. 2J-F100-53-4,	WP 040 00
Digital electronic engine control (DEEC) -	T.O. 2J-F100-53-4,	WP 007 00
Fuel purge removal/installation		
module leak check		
Dual ignition exciter - removal/installation	T.O. 2J-F100-53-4,	WP 026 00
EDU - removal/installation	T.O. 2J-F100-53-4,	WP 023 00
Electrical special purpose cables - removal/installation	T.O. 2J-F100-53-4,	WP 019 00
FTIT sensing immersion thermocouples - removal/installation/system check/seating verification	T.O. 2J-F100-53-4,	WP 008 00
Fuel manifolds - removal/installation	T.O. 2J-F100-53-7,	WP 011 00 WP 706 00
Fuel oil cooler - removal/installation	T.O. 2J-F100-53-4,	WP 028 00
Gearbox module - removal/installation	T.O. 2J-F100-53-5,	WP 106 00
	TDP F100-6,	Para. 5-21
	T.O. 2J-F100-53-5,	WP 721 00
	TDP-F100-6,	Para. 5-51

Table 3. References For Maintenance Action Required (continued)

Maintenance Item	Reference
Generator rotor - removal/installation/inspection	T.O. 2J-F100-53-4, WP 022 00
Generator stator - removal/installation/ inspection	T.O. 2J-F100-53-4, WP 021 00
Igniter (engine main) immersion depth check	T.O. 2J-F100-53-4, WP 028 00
Light-off detector - removal/installation	T.O. 2J-F100-53-4, WP 041 00
Main fuel control - removal/installation/leak check	T.O. 2J-F100-53-4, WP 009 00
Main fuel control module -	T.O. 2J-F100-53-4, WP 009 00
Metering valve EHV replacement	
RCVV EHV replacement	
Mode solenoid and screen assembly replacement	
Ignition switch replacement	
Start bleed solenoid valve replacement	
Tt2 sensor assembly	
Main fuel gear pump - removal/installation	T.O. 2J-F100-53-4, WP 005 00
Main spark igniter - removal/installation	T.O. 2J-F100-53-4, WP 024 00
Main oil pump assembly - removal/installation	T.O. 2J-F100-53-4, WP 032 00
Main oil filter - removal/installation	T.O. 2J-F100-53-4, WP 030 00
No. 1 bearing compartment - airflow check	T.O. 2J-F100-53-5, WP 430 00
No. 1 bearing compartment - vacuum check	T.O. 2J-F100-53-5, WP 430 00
No. 2 and 3 bearing compartment - vacuum check	T.O. 2J-F100-53-5, WP 429 00
No. 4 bearing compartment - vacuum check	T.O. 2J-F100-53-5, WP 429 00
No. 5 bearing compartment - vacuum check	T.O. 2J-F100-53-5, WP 432 00
No. 5 bearing compartment - airflow check	T.O. 2J-F100-53-5, WP 431 00

Table 3. References For Maintenance Action Required (continued)

Maintenance Item	Reference
Nozzle position transmitter - removal/installation	T.O. 2J-F100-53-4, WP 045 00
Oil tank - removal/installation	T.O. 2J-F100-53-4, WP 031 00
P&D valve - removal/installation	T.O. 2J-F100-53-4, WP 011 00
Pressure transmitter - removal/installation	T.O. 2J-F100-53-4, WP 029 00
Ps2 probe - removal/installation	T.O. 2J-F100-53-4, WP 015 00
Quad N1 electrical sensor - removal/installation	T.O. 2J-F100-53-4, WP 014 00
RCVV linear actuating cylinders - removal/installation	T.O. 2J-F100-53-4, WP 034 00
RCVV push-pull feedback cable rigging	T.O. 2J-F100-53-4, WP 102 00
Shafts, flexible, primary and secondary actuator, convergent nozzle - removal/installation	T.O. 2J-F100-53-4, WP 042 00

Table 4. Engine Anomalies Troubleshooting Procedures

Anomaly	WP No.
NOTE All work package references are to T.O. 2J-F100-11-2.	
System Fault Light Illuminated	504 00
EMS Fault Light Illuminated	505 00
Engine Caution Light Illuminated	506 00
Secondary Caution Light Illuminated	507 00
Augmentor Mn Fault Light Illuminated	508 00
Start Anomaly - Primary Mode	509 00
Engine Instability - Primary Mode	510 00
Engine Anomaly, Idle to Intermediate 9MIL) - Primary Mode	511 00
Augmentor anomaly	512 00
Exhaust Nozzle Position Out of Limits - Primary Mode	513 00
Idle Speed Out of Limits	514 00
EPR vs N1C2 Out of Limits, Intermediate (MIL) - Primary Mode	515 00
Maximum Fuel Flow Exceeds Limits	516 00
Anti-Ice System Malfunction	517 00
Ignition System Anomaly	518 00
DEEC Pressure Transducer Malfunction	519 00
Mn System Malfunction	520 00
Fault Reset Malfunction	521 00
Mode Select Malfunction	522 00
Secondary Mode Anomaly	523 00
Exhaust Nozzle Position Out of Limits - Secondary Mode	524 00

Table 4. Engine Anomalies Troubleshooting Procedures (continued)

Anomaly	WP No.
RCVV Position Out of Limits - Secondary Mode	525 00
CIVV Malfunction - Secondary Mode	526 00
Main Fuel Pump Filter ∆P Indicator Extended	527 00
Engine Inlet - Fuel Leakage	528 00
Low or Fluctuating Oil Pressure Out of Limits	529 00
Main Oil Pressure High Out of Limits	530 00
Main Oil Pressure Rise Between Idle and Intermediate (MIL) Out of Limits	531 00
Oil Smoke Emitting From Exhaust Nozzle, Fan Inlet Oil Puddling, High Oil Consumption or Internal Oil Leakage	532 00
Overboard Fuel/Oil Drainage Out of Limits	533 00
Engine No-Start	534 00
Engine Dieout	535 00
FTIT System Anomaly	536 00
RCVV Position Out of Limits - Primary Mode	537 00
CIVV Position Out of Limits - Primary Mode	538 00
N2 or N2C2.5 vs Tt2 Out of Limits - Secondary Mode	539 00
N1 Overspeed	540 00
N2 Overspeed	541 00
FTIT Spread Out of Limits	542 00
Augmentor Sprayring Leakage	543 00
Abnormal Engine Noise or Vibration (Non-Augmented)	544 00
Oil Consumption Check Run	545 00
Oil Contamination Check Run	546 00

Table 5. Event Code and Fault Code Displays

Display	Title	WP No.
NOTE All work package references are in T.O. 2J-F100-11-2.		
1000 STAGNATION	Non-Recoverable Stall - Idle and Above	550 00
1020 ENG STALL	Engine Stall - Idle and Above	552 00
1030 ENG DIEOUT	Engine Dieout	553 00
1040 A/B NO LITE	Augmentor Events	554 00
1041 A/B BLOWOUT	Augmentor Events	554 00
1050 HOT G START	Hot Ground Start	555 00
1060 HOT A START	Hot Air Start	556 00
1070 FTIT O/TEMP	FTIT Overtemperature	557 00
1080 N1 O/SPEED	N1 Overspeed	558 00
1090 N2 O/SPEED	N2 Overspeed	559 00
1120 NO START	Engine No Start	562 00
1151 RCVV FLTR A	FCVV Flutter	565 00
1152 HIGH N2C25	N2C2.5 High Out Of Limits	565 00
1170 ST BLD STRP	Start Bleed System Malfunction	567 00
1180 A/I O/TEMP	Anti-Ice Overtemperature	568 00
1190 LOW MOP	Low MOP	569 00
1191 HIGH MOP	High MOP	569 00
1200 to 1220	Pilot-Reported Events	570 00
1300 EPR ERROR	EPR Error Event	575 00
1340 N1 SUPPRESS	N1 Suppression Event	578 00
2000 to 2999 DEEC	Internal DEEC Malfunction	580 00
3000 to 3999 EDU	Internal EDU Malfunction	590 00
4000 AJ SYSTEM	CENC Resolver Position Out of Range	600 00
4001 AJ SYSTEM	Exhaust Nozzle Request Out of Range	600 00
4002 AJ SYSTEM	CENC EHV Circuit	600 00
4003 AJ SYSTEM	ENP Out of Range	600 00

Table 5. Event Code and Fault Code Displays (continued)

Display	Title	WP No.
4010 CIVV SYSTEM	CIVV Resolver Position Out of Range	601 00
4011 CIVV SYSTEM	CIVV Position Out of Limits	601 00
4012 CIVV SYSTEM	CIVV EHV Circuit	601 00
4013 CIVV SYSTEM	CIVV EHV Circuit Malfunction	601 00
4020 SVP SYSTEM	AFC Segment Sequencing Valve Resolver Position Out of Range	602 00
4021 SVP SYSTEM	AFC Segment Sequencing Valve Position Out of Limits	602 00
4022 SVP SYSTEM	AFC Segment Sequencing Valve EHV Circuit	602 00
4030 WFAC SYSTEM	AFC Core Metering Valve Resolver Position Out of Range	603 00
4031 WFAC SYSTEM	AFC Core Metering Valve Position Out of Limits	603 00
4032 WFAC SYSTEM	AFC Core Metering Valve EHV Circuit	603 00
4040 WFAD SYSTEM	AFC Duct Metering Valve Resolver Position Out of Range	604 00
4041 WFAD SYSTEM	AFC Duct Metering Valve Position Out of Limits	604 00
4042 WFAD SYSTEM	AFC Duct Metering Valve EHV Circuit	604 00
4050 RCVV SYSTEM	RCVV Resolver Signals Differ	605 00
4051 RCVV SYSTEM	RCVV1 Resolver (Left) Position Out of Range	605 00
4052 RCVV SYSTEM	RCVV Position Out of Limits	605 00
4053 RCVV SYSTEM	MFC RCVV EHV Circuit	605 00
4054 RCVV SYSTEM	RCVV2 Resolver (Right) Position Out of Range	605 00
4060 WFGG SYSTEM	MFC Metering Valve Resolver Out of Range	606 00
4061 WFGG SYSTEM	MFC WFGG Resolver Out of Range	606 00
4062 WFGG SYSTEM	MFC WFGG Resolver Out of Range	606 00

Table 5. Event Code and Fault Code Displays (continued)

Display	Title	WP No.
4063 WFGG SYSTEM	MFC Metering Valve EHV Circuit	606 00
4064 WFGG SYSTEM	MFC WFGG Position Out of Limits	606 00
4070 FTIT SYSTEM	FTITA and/or FTITB Temperature Signal Out of Range	607 00
4071 FTIT SYSTEM	Real or Predicted FTIT Overtemperature	607 00
4072 FTIT SYSTEM	DEEC FTITA Out of Range	607 00
4073 FTIT SYSTEM	DEEE FTITB Out of Range	607 00
4074 FTIT SYSTEM	EDU FTIT Exceeds Scheduled Limit	607 00
4075 FTIT SYSTEM	Multiple FTIT Probe Malfunction	607 00
4076 FTIT SYSTEM	EDU vs DEEC FTITA Out Of Limits	607 01
4077 FTIT SYSTEM	EDU vs DEEC FTITB Out Of Limits	607 01
4080 N1 SYSTEM	N1 Overspeed	608 00
4081 N1 SYSTEM	N1A and/or N1B Speed Signal Out of Range	608 00
4082 N1 SYSTEM	N1 Speed Signals Out of Range	608 00
4083 N1 SYSTEM	EDU N1 Speed Signals Out of Range	608 00
4090 N2 SYSTEM	N2 Overspeed	609 00
4091 N2 SYSTEM	N2A and/or N2B Speed Signals Out of Range	609 00
4092 N2 SYSTEM	N2A, N2B, and N2C Speed Signals Out of Range	609 00
4093 N2 SYSTEM	N2C Speed Signal Out of Range	609 00
4100 Tt2 SYSTEM	Tt2A Signal Out of Range	610 00
4101 Tt2 SYSTEM	Tt2B Signal Out of Range	610 00
4102 Tt2 SYSTEM	Tt2A and Tt2B Signals Differ	610 00
4110 PLA SYSTEM	MFC PLA Resolver Signals Differ	611 00
4111 PLA SYSTEM	MFC PLA1 Resolver Signal Out of Range	611 00
4112 PLA SYSTEM	MFC PLA2 Resolver Signal Out of Range	611 00
4120 PS2 PROBE	Ps2 Probe Heater Malfunction	612 00
4121 PS2 PROBE	Ps2 Pressure Out of Limits	612 00
4122 PB SENSOR	Pb Pressure Out of Limits	613 00
4123 PT6 SENSOR	Pt6 Pressure Out of Limits	614 00
4130 SEC PS2	MFC SEC Ps2 Sensor	615 00
4140 SEC TT2	MFC SEC Tt2 Sensor	616 00
4170 ELEC GEN	DEEC Power Supply	619 00
4180 MN SIGNAL	Mn Input to DEEC Out of Range	620 00
4190 AIRCRAFT SWITCH	Aircraft Mode Select Switch/Solenoid Malfunction	621 00
4191 AIRCRAFT SWITCH	Fault Reset Switch Malfunction	621 00
4192 A/C SIGNAL	Aircraft Identification Switch	622 00
4194 PILOT SWITCH	Pilot Data Switch	623 00

Table 5. Event Code and Fault Code Displays (continued)

Display	Title	WP No.
4195 IAR/GIT FAIL	Idle Area Reset Signal or Ground Idle Thrust Signal Failure	628 00
4196 MODE SEL DISAGREE	Redundant Mode Select Signals Disagree	629 00
4197 F-16 A/C WIRING	F-16 Aircraft Wiring Modification Signal Failure	630 00
4198 IAR CIRCUIT	IAR Circuit Malfunction	631 00
4199 GIT CIRCUIT	GIT Circuit Malfunction	632 00
4200 RES EXC SIG	Resolver Circuit A	624 00
4201 RES EXC SIG	Resolver Circuit B	624 00
4210 UART	EDU/DEEC Communication (UART)	625 00
4220 MOP RANGE	Main Oil Pressure (MOP) Signal Out of Range	626 00
4230 A/B CONTROL	AFC Core/Duct Metering or Segment Sequencing Valve EHV Circuit	627 00
4231 EHV CURRENT ERROR	EHV Current Error (Sum of AFC, CIVV, CENC EHV)	627 00
4240 EHV CURRENT ERROR	EHV Current Error (Sum of WFMFC and RCVV EHV)	627 00
4250 A/I SYSTEM	Anti-ice Thermocouple Out of Range	627 01
4251 A/I SYSTEM	Anti-ice Valve Failed Open	627 01
4252 A/I SYSTEM	Anti-ice Valve Failed Closed	627 01
4330 INTERNAL DEEC/EDU O/TEMP	Internal DEEC Overtemperature	636 00
4331 INTERNAL DEEC/EDU O/TEMP	Internal EDU Overtemperature	636 00
4370 EDU/DEEC DIS	DEEC VS EDU Engine Disagreement	637 00
4410 MODE SW DIS	EDU MFC Mode Feedback Circuit Malfunction	638 00
Deleted.		
5001 A/B ANOMALY	Augmentor Blowout/Recycle	645 00
5002 A/B ANOMALY	Augmentor No-Light/Recycle	645 00
5009 FTITA DELTA	DEEC VS EDU FTITA Out of Limits	646 00
5010 FTITB DELTA	DEEC VS EDU FTITB Out of Limits	646 00
5011 FTIT1	No. 1 FTIT Probe Signal	646 00
5012 FTIT2	No. 2 FTIT Probe Signal	646 00
5013 FTIT3	No. 3 FTIT Probe Signal	646 00
5014 FTIT4	No. 4 FTIT Probe Signal	646 00
5015 FTIT5	No. 5 FTIT Probe Signal	646 00
5016 FTIT6	No. 6 FTIT Probe Signal	646 00
5017 FTIT7	No. 7 FTIT Probe Signal	646 00
5140 A/C TYPE DISAGREE	Aircraft Type Disagreement	648 00
5170 UART ADVIS	DEEC/EDU Communication (UART) Interruption	649 00
5180 MN ADVIS	Mn Input To DEEC Short Term Out of Range	649 01
7001	Transient Data Present	647 00

Table 6. Engine Standard Troubleshooting Procedures

Title	WP No.
NOTE All work package references are to T.O. 2J-F100-11-2.	
EDU Test Procedure Using EAU	650 00
Downloading and Reviewing Data Using CEDS	651 00
Downloading and Reviewing Data Using DTS	651 01
DEEC Test Procedure Using EAU	652 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	653 00
EAU Built-In Test	654 00
Changing EDU Documentary Data Using CEDS	655 00
Clearing Engine Faults/Events and Data Using CEDS	656 00
Uploading Data to Engine Tracking System Using CEDS	657 00
Revising EDU and DEEC Software Using CEDS	658 00
Testing Light-Off Detector Using CEDS	659 00
Downloading DCU-Stored Data to CEDS	660 00
Main Fuel Pump Fuel Pressure Analysis	661 00
Augmentor Fuel System Analysis	662 00
Secondary Mode Fuel System Analysis	663 00
Ignition System Analysis	664 00
Electrical Cable Checks	665 00
Compressor Bleed System Functional Check	667 00
Engine, Internal and External - Cleaning	670 00
DEEC Pressure Sensing System Analysis	675 00

3. GENERAL TROUBLESHOOTING PROCEDURE.
(See tables 4 and 5, and Table 7.)

a. When fault light illuminates or an operational anomaly occurs, perform following procedure to identify the cause of problem and appropriate troubleshooting procedure.

(1) Perform engine fault data review using EAU per WP 651 00. Do not clear faults, if present.

(2) If EDU event codes (1000 to 1999) are present, refer to table 5 for troubleshooting procedures.

(3) If an operational anomaly occurs, refer to table 4 for troubleshooting procedures.

(4) If DEEC fault codes (2000 to 2999) are present, refer to table 5 for troubleshooting procedures.

(5) If EDU fault codes (3000 to 3999) are present, refer to table 5 for troubleshooting procedures.

(6) If System fault codes (4000 to 4999) are present, check connectors indicated in table 7 for looseness and refer to table 5 for troubleshooting procedures.

(7) If EDU advisory fault codes (5000 to 5999) are present, refer to table 5 for troubleshooting procedures.

(8) If no event or fault codes are present, and a fault light is on, troubleshoot per WP 504 00 (System Fault Light Illuminated).

Table 7. System Fault Codes and Applicable Connector Numbers

NOTE

Loose connectors may cause system fault flags to trip in the DEEC. If connector is loose, clean and tighten connector, reset fault, and rerun engine.

Fault	Connectors
4000	P85, P91
4002	P85, P92
4003	P7, P51
4010	P85, P93
4012	P85, P94
4020	P84, P99
4022	P84, P98
4030	P84, P101
4032	P84, P100
4040	P84, P103
4042	P84, P102
4050	P85, P89, P90
4051	P85, P89
4053	P83, P111
4054	P85, P90
4060	P83, P109
4061	P83, P109
4062	P83, P109
4063	P83, P108
4070	P81
4072	P81
4073	P81
4075	P48
4081	P53, P82
4082	P53, P82
4083	P121, P143
4091	P82, P118
4092	P82, P118
4093	P50, P118

Table 7. System Fault Codes and Applicable Connector Numbers (continued)

Fault	Connectors
4100	P36, P81
4101	P37, P81
4102	P36, P37, P81
4110	P83, P107
4111	P83, P107
4112	P83, P107
4130	P112, P121
4140	P112, P121
4170	P82, P118
4192	P1, P82
4194	P2
4200	P83, P84, P85, P89, P93, P99, P101, P103, P107, P109
4201	P83, P85, P90, P91, P107, P109
4210	P82, P121
4220	P8, P51
4230	P84, P98, P100, P102
4231	P84, P85, P92, P94, P98, P100, P102
4240	P83, P108, P111
4250	P70
4251	P2, P51, P85, P149, P150
4252	P2, P51, P85, P149, P150
4290	P2

Table 7. System Fault Codes and Applicable Connector Numbers (continued)

Fault	Connectors
Deleted.	
5001	P26(L or R), P28(L or R), P30, P35, P84, P97, P104, P119
5002	P26(L or R), P28(L or R), P30, P35, P84, P97, P104, P119
5010	P81
5011	P38, P48
5012	P39, P48
5013	P40, P48
5014	P41, P48
5015	P42, P48
5016	P43, P48
5017	P44, P48

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT LIGHT ILLUMINATED

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Idle Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures when SYSTEM FAULT light illuminates.

2. EMS SYSTEM FAULT LIGHT ILLUMINATED.

(See Table 1.)

a. Description:

(1) Internal DEEC or external system faults are detected by the DEEC and EDU. The SYSTEM FAULT light is illuminated or the aircraft flag is tripped. The DEEC takes corrective action depending on the fault. Possible DEEC fault accommodation includes:

Transfer to Secondary Mode

Inhibit augmentation

Limit augmentation

Use redundant value

Substitute calculated value

Ignore fault

(2) The EDU does not affect engine operation, but detects and records anomaly data.

Table 1. SYSTEM FAULT Light Illuminated

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Troubleshoot wiring to system fault light.	a. No defects present.	a. Go to step 3.
		b. Defects present.	b. Repair as required.
3.	Perform IDLE functional check. Check for SYSTEM FAULT light. If fault light illuminates, replace components in the following order until engine operates properly: • EDU • DEEC	a. System fault light does not illuminate.	a. Return engine to service.
		b. System fault light illuminates.	b. Replace next component and repeat step 3.

WORK PACKAGE

TECHNICAL PROCEDURES

EMS FAULT LIGHT ILLUMINATED

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Test	WP 002 00
Idle Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedures Using EAU	WP 652 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures when EMS FAULT light illuminates.

2. EMS FAULT LIGHT ILLUMINATED.

(See Table 1.)

a. Description.

(1) The EMS FAULT light will illuminate when an EDU internal fault is detected. The engine will function normally except for data collection and event detection modes.

(2) The light will normally be accompanied by a fault code.

Table 1. EMS FAULT Light Illuminated

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults are present.	b. Go to step 2.
2.	Check test cell EMS FAULT light wiring.	a. No defects present.	a. Go to step 3.
		b. Defects present.	b. Repair as required.
3.	Perform IDLE functional check. Check for EMS FAULT light.	a. EMS FAULT light does not illuminate.	a. Return engine to service.
		b. EMS FAULT light illuminates.	b. Replace EDU and repeat step 3.

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE CAUTION LIGHT ILLUMINATED

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Secondary Mode Functional Check	WP 215 00
Idle Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures when ENGINE CAUTION light illuminates.

2. ENGINE CAUTION LIGHT ILLUMINATED.

(See Table 1 and Figure 1.)

a. ENGINE CAUTION light will illuminate if any of the following conditions exists:

Augmentation inhibited
Mn out of range
Anti-ice valve malfunctions
Anti-ice overtemperature
Dual DEEC/FTIT anomalies
UART malfunctions

b. This light will normally be accompanied by a system fault code.

Table 1. ENGINE CAUTION Light Illuminated

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Check engine caution light circuit wiring. (See figure 1.)	a. No defects found.	a. Go to step 3.
		b. Defects found.	b. Repair as required.
3.	Perform IDLE functional check. Check for ENGINE CAUTION light. If caution light illuminates, replace components in the following order until engine operates properly:	a. ENGINE CAUTION light does not illuminate.	a. Return engine to service.
	• EDU • Power and speed cable	b. ENGINE CAUTION light illuminates.	b. Replace next component and repeat step 3.

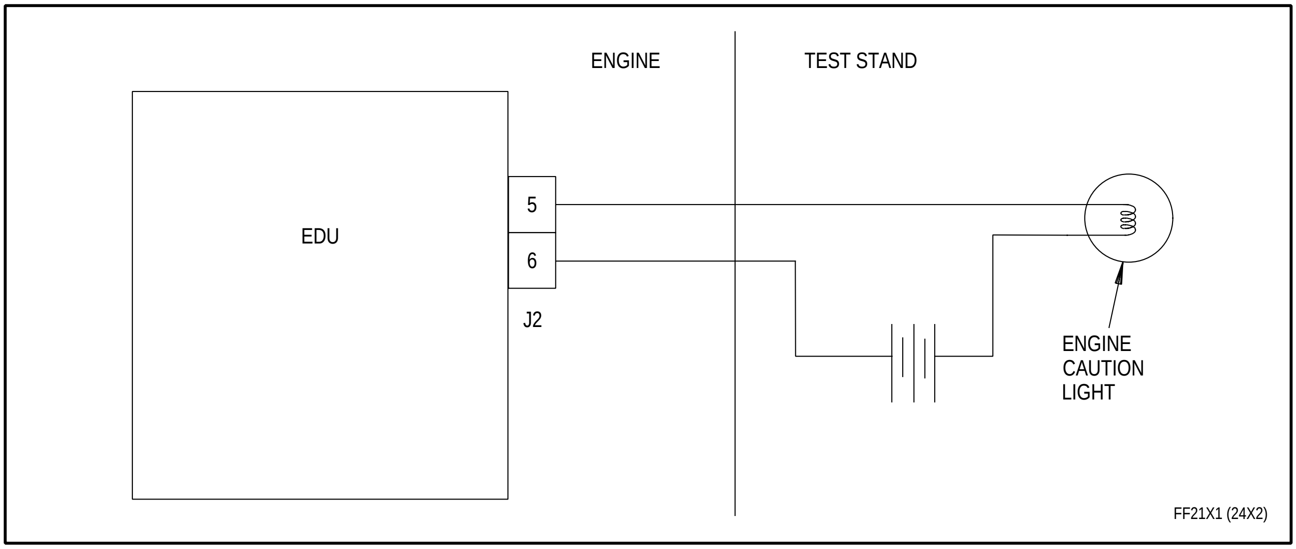


Figure 1. Engine Caution Light Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SECONDARY CAUTION LIGHT ILLUMINATED

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 7	0				
8 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Secondary Mode Functional Check	WP 215 00
Engine Trouble - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedures Using EAU	WP 652 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	SECONDARY CAUTION Light Illuminated	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedure when SECONDARY CAUTION light illuminates.

2. SECONDARY CAUTION LIGHT ILLUMINATED.

(See Table 1.)

a. Description:

(1) DEEC automatically transfers engine to Secondary mode due to significant engine system faults and SECONDARY CAUTION light illuminates. The following faults will cause DEEC to transfer to Secondary mode:

- N1 overspeed
- N2 overspeed
- FTIT overtemperature
- N1A and N1B signal loss
- N2A and N2B signal loss
- PLA1 and PLA2 signal loss
- Tt2A and Tt2B signal loss
- Pb and Ps2 signals out of limits
- DEEC power supply loss
- RCVV EHV malfunction
- MFC metering valve EHV malfunction
- Resolver circuit malfunction
- Internal DEEC malfunctions

(2) Light indicates mode solenoid switch in MFC has shuttled to SECONDARY (closed circuit) position.

(3) Event Fault Code 1200: Auto transfer to Secondary mode present.

(4) Event fault codes may not be present if transfer to SEC mode was caused by DEEC power supply loss (no DEEC/EDU communication), or if aircraft/test cell operator commanded transfer.

Table 1. SECONDARY CAUTION Light Illuminated

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Check mode select switch circuit. Disconnect P2 from engine. Perform the following resistance checks. Note mode select switch position. CONN P2 / PINS / MODE SELECT 1. 31 to 32 PRIMARY 2. 31 to 32 SECONDARY 3. 31 to GND 4. 32 to GND	a. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	a. Go to step 3.
		b. Resistance checks out of limits	b. Repair test cell cable or mode solenoid switch as required.

Table 1. SECONDARY CAUTION Light Illuminated (continued)

Step	Procedure	Result	Corrective Action
3.	Check mode solenoid module circuit. Perform following resistance checks:		
	a. CONN PIN P82 — CONN PIN J2 1. n to 31 CONN PINS 2. P82 n to GND 3. J2 31 to GND	a.1. Resistance checks within limits: 1. 21 to 42 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	a.1. Go to step 4.
		a.2. Resistance checks out of limits.	a.2. Disconnect P121 from engine. Go to b.
	b. CONN PIN P82 — CONN PIN P121 1. n to B CONN PINS 2. P82 n to GND 3. P121 B to BND	b.1. Resistance checks within limits: 1. 21 to 42 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	b.1. Replace EDU.
		b.2. Resistance checks out of limits	b.2. Disconnect P112 from MFC mode solenoid module. Go to c.
	c. CONN J112 — PINS 1. J to K 2. J to GND 3. K to GND	c.1. Resistance checks within limits: 1. 21 to 42 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	c.1. Replace power and speed cable.
		c.2. Resistance checks out of limits.	c.2. Replace MFC mode solenoid module.

Table 1. SECONDARY CAUTION Light Illuminated (continued)

Step	Procedure	Result	Corrective Action
4.	Check mode select circuit. Perform the following resistance checks. Position mode select switch as noted.		
	a. CONN PINS P82 1. FF to GG 2. FF to GND 3. GG to GND	a.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	a.1. Go to step 5.
		a.2. Resistance checks out of limits.	a.2. Disconnect P112 from MFC. Go to b.
	b. CONN PINS J112 1. A to B 2. A to GND 3. B to GND 4. C to D 5. C to GND 6. D to GND	b.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Replace power and speed cable.
		b.2. Resistance checks out of limits.	b.2. Replace MFC.
	c. CONN PINS P82 — MODE SELECT 1. k to BB — PRIMARY 2. k to BB — SECONDARY 3. K to GND 4. BB to GND	c.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. LT 5 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	c.1. Go to step 5.
		c.2. Resistance checks out of limits.	c.2. Disconnect P1 from J1. Go to d.
	d. CONN PINS P1 — MODE SELECT 1. 24 to 25 — PRIMARY 2. 24 to 25 — SECONDARY 3. 24 to GND 4. 25 to GND	d.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. LT 5 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	d.1. Replace power and speed cable.
		d.2. Resistance checks out of limits.	d.2. Repair test cell wirings.

Table 1. SECONDARY CAUTION Light Illuminated (continued)

Step	Procedure	Result	Corrective Action
5.	Perform Secondary Mode functional check and check engine operation. Replace components in the following order until engine operates properly:	a. Engine transfers to modes as requested by mode select switch.	a. Return engine to service.
	• MFC mode solenoid module • MFC • DEEC	b. Engine does not transfer to modes as requested by mode select switch.	b. Replace next component and repeat step 5.

WORK PACKAGE

TECHNICAL PROCEDURES

AUGMENTOR/MN FAULT LIGHT ILLUMINATED

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test ----------------------------------	T.O. 2J-F100-11-2
Engine Troubleshooting - General -----------------	WP 501 00
Downloading and Reviewing Data Using CEDS -----------	WP 651 00
DEEC Test Procedures Using EAU ------------------	WP 652 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS ----	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures when AUGMENTOR/MN FAULT light illuminates.

2. AUGMENTOR/MN FAULT LIGHT.

(See Table 1.)

a. Description:

(1) The AUGMENTOR/MN FAULT light illuminates when certain engine system faults are detected by the DEEC, and will usually be accompanied by EDU Event Code 1220 - AUG/MN inhibit. Augmentor-associated faults cause the DEEC to inhibit or limit augmentation, and illuminates light. Mach number-associated faults cause the DEEC to illuminate AUGMENTOR/MN FAULT light and use default mach number, however, augmentation is still possible.

(2) The following faults will cause the AUGMENTOR/MN FAULT light to illuminate:

- Mn input out of limits
- Pb pressure signal out of limits
- Ps2 pressure signal out of limits
- Pt6 pressure signal out of limits
- AFC segment sequencing valve EHV malfunction
- AFC core metering valve EHV malfunction
- AFC duct metering valve EHV malfunction
- ENP out of limits
- CIVV position out of limits
- Core metering valve position out of limits
- Duct metering valve position out of limits
- Segment sequencing valve position out of limits
- CENC EHV malfunction
- CIVV EHV malfunction

(3) The ENGINE CAUTION light will illuminate and EDU Event Code 1220 will be present for all but Mn signal malfunctions.

Table 1. AUGMENTOR/MN FAULT Light Illuminated

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Check Mn simulator as follows:		
	a. Set Mn (octal) reading on Mn simulator to 0214. Check Mn display on EMSE (word 79).	a.1. Mn is 0.14 to 0.16	a.1. Go to b.
		a.2. Mn out of limits	a.2. Repair or replace Mn simulator.
	b. Set Mn (octal) reading on Mn simulator to 1071. Check Mn display on EMSE (word 79).	b.1. Mn is 1.47 to 1.49.	b.1. Go to step 3.
		b.2. Mn out of limits	b.2. Repair or replace Mn simulator.
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
3.	Check that EDU data has been reviewed and stored; then clear EDU data.		
4.	Perform IDLE functional check. Check for AUGMENTOR/MN FAULT light. Replace components in the following order, if component has not been previously changed, until engine operates properly:	a. AUGMENTOR MN FAULT light does not illuminate.	a. Return engine to service.
	• EDU • Power and speed cable	b. AUGMENTOR MN fault light illuminates.	b. Replace next component and repeat steps 3 and 4.

WORK PACKAGE

TECHNICAL PROCEDURES

START ANOMALY - PRIMARY MODE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	5				
3	0				
4 - 5	5				
6 - 11	0				
12 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Final Dress (After Installation Into AF 8624151 Thrust Frame)	WP 102 00
Engine Start Procedures	WP 210 00
Fuel System Contamination	WP 305 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Main Fuel Pump Fuel Pressure Analysis	WP 661 00
Ignition System Analysis	WP 664 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00
Gearbox Module	T.O. 2J-F100-53-11
Gearbox Module	WP 001 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Start Anomaly - Primary Mode	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for start anomaly in primary mode.

2. START ANOMALY - PRIMARY MODE.

(See Figures 1 through 3 and Table 1.)

a. Description:

(1) No Engine Start: Engine does not begin combustion (indicated by FTIT increase) after throttle is moved to IDLE during start attempt or engine ignition time limits are exceeded. An engine no-start is usually due to lack of fuel or ignition.

(2) Hung Start: Engine accelerates to approximately 6300 to 7000 N2 rpm then FTIT and N2 generally stabilize. This is usually caused by low fuel flow scheduling.

(3) Hot Start A: Engine accelerates to no-more-than 6300 N2 rpm, then FTIT rises rapidly toward overtemperature. This is usually caused by high fuel flow scheduling.

(4) Hot Start B: Engine accelerates more than 6300 N2 rpm followed by an audible stall with N2 decreasing and FTIT increasing toward overtemperature. This is usually caused by improper fuel or airflow scheduling or a high-pressure compressor with low airflow.

Table 1. Start Anomaly - Primary Mode

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	If no N2 rpm indication present during start attempt, perform following inspections. If N2 within limits, go to step 3.		
	a. Check condition of PTO driveshaft shear section. (See figure 1.)	a.1. Driveshaft not sheared.	a.1. Go to b.
		a.2. Driveshaft sheared.	a.2. Replace PTO driveshaft. Perform b. before attempting restart.
	b. Inspect fan inlet and turbine exhaust areas for damage or foreign objects.	b.1. No damage or foreign objects.	b.1. Go to c.
		b.2. FOD present.	b.2. Perform complete borescope inspection.
	c. Check test cell N2 rpm instrumentation.	c.1. Instrumentation functions properly.	c.1. Go to step 3.
		c.2. Instrumentation does not function properly.	c.2. Repair instrumentation as required.
3.	Perform following engine visual inspections:		
	a. Perform engine rotation inspections:	a.1. Engine rotates freely.	a.1. Go to b.
	Core - Rotate input shaft on gearbox with wrench. Check for binding or unusual noises.	a.2. Engine does not rotate freely.	a.2. Teardown engine as required to repair damaged hardware.
	Fan - Rotate 1st fan blades by hand.		
	b. Inspect for fuel leak inside fan ducts.	b.1. No leak.	b.1. Go to c.
		b.2. Fuel in fan ducts.	b.2. Repair fuel leak as required.

Table 1. Start Anomaly - Primary Mode (continued)

Step	Procedure	Result	Corrective Action
3. (cont'd)	c. Check test cell starter gearbox for proper operation: • Coupling jaw alignment • Disengagement switch • Air starter pressure supply (SIP)	c.1. Test cell starter operates normally.	c.1. Go to step 4.
		c.2. Test cell starter does not operate normally.	c.2. Repair test cell starter as required.
		c.3. Test cell starter abruptly applies or releases torque and any of the following occur: •Air starter is re-engaged while engine is rotating. •Starter shaft shears. •Starter to gearbox coupling adapter disengages during start. •Starter hose blows off. •Gearbox coupling shears.	c.3. Replace gearbox spur gears. Refer to T.O. 2J-F100-53-11, WP 001 00.
4.	Check fuel supply to engine. Motor engine with ignition OFF and throttle at IDLE. Check for fuel fog from exhaust duct.	a. Fuel fogs from exhaust duct during motoring.	a. Go to step 5.
		b. No fuel fog.	b. Check the following: 1. Throttle rigging. 2. Test cell fuel pump switches ON. 3. Fuel shut-off valve open. 4. Fuel at MFP inlet. 5. Pfo pressure 25 to 65 psig.
		c. Perform MFP fuel pressure analysis.	

Table 1. Start Anomaly - Primary Mode (continued)

Step	Procedure	Result	Corrective Action
5.	Check ignition system:	a.1. Green (on) ignition light illuminates.	a.1. Go to b.
	a. Ensure test cell ignition switches are ON.	a.2. Amber (off) ignition status light illuminates.	a.2. Press switch to obtain green (ON) status light.
	b. Check P119 for security, contamination, or damage.	b.1. Connector serviceable.	b.1. Go to step 6.
		b.2. Connector loose.	b.2. Secure P119. Repeat start attempt.
		b.3. Connector damaged.	b.3. Use specified alcohol or freon degreaser to clean connectors. Replace ignition cable or generator stator as required.
6.	Ensure test cell N2 and FTIT instrumentation functioning properly. Use EMSE to verify readings.	a. Instrumentation correct.	a. Go to step 7.
		b. FTIT differs by more than 27°F (15°C) or N2 by ±280 rpm.	b. Repair or replace test cell instrumentation.
7.	Ensure starter motor operates properly.	a. Engine accelerates to 2100 N2 rpm (motoring speed) in less than 20 seconds.	a. Go to step 8.
		b. Engine acceleration inadequate.	b. Repair or replace starter motor or air pressure source.
8.	Check throttle linkage:		
	a. Ensure MFC PLA linkage secure and rotates smoothly.	a.1. Linkage serviceable.	a.1. Go to b.
		a.2. Linkage damaged.	a.2. Replace MFC.
	b. Check throttle rigging.	b.1. Rigging within limits.	b.1. Go to step 9.
		b.2. Rigging out of limits.	b.2. Rig throttle as required.

Table 1. Start Anomaly - Primary Mode (continued)

Step	Procedure	Result	Corrective Action
9.	Inspect Pb sense line tubes for leaks, chafing and blockage. See figure 2.	a. No leaks, chafes, or blockage.	a. Go to step 10.
		b. Leaks, chafes, or blockage.	b. Repair or replace Pb sense tubes as required.
10.	Inspect MFP filter and MFC fuel filter.	a. No contamination found.	a. Go to step 11.
		b. Either filter contaminated.	b. Refer to fuel system contamination procedures.
11.	Check generator main ignition circuits. Perform following resistance checks. See figure 3.		
	CONN J119 PINS	a. Resistance checks within limits:	
	1. C to D	1. LT 10 OHMS	a. Go to step 12.
	2. C to GND	2. GT 100,000 OHMS	
	3. D to GND	3. GT 100,000 OHMS	
	4. G to H	4. LT 10 OHMS.	
	5. G to GND	5. GT 100,000 OHMS	
	6. H to GND	6. GT 100,000 OHMS	
		b. Resistance checks out of limits.	b. Replace generator stator.
12.	Check MFC ignition switch. Perform following resistance checks. See figure 3.	a. Resistance checks within limits:	a. Go to step 13.
	CONN J113 PINS		
	(PLA at CUTOFF)		
	1. A to B	1. LT 5 OHMS	
	2. A to GND	2. GT 100,000 OHMS	
	3. B to GND	3. GT 100,000 OHMS	
	4. D to E	4. LT 5 OHMS	
	5. D to GND	5. GT 100,000 OHMS	
	6. E to GND	6. GT 100,000 OHMS	
	(PLA at IDLE)		
	7. A to B	7. GT 100,000 OHMS	
	8. A to GND	8. GT 100,000 OHMS	
	9. B to GND	9. GT 100,000 OHMS	
	10. D to E	10. GT 100,000 OHMS	
	11. D to GND	11. GT 100,000 OHMS	
	12. E to GND	12. GT 100,000 OHMS	
		b. Resistance checks out of limits.	b. Replace MFC ignition switch module.

Table 1. Start Anomaly - Primary Mode (continued)

Step	Procedure	Result	Corrective Action
13.	Perform gas generator ignition system analysis.	a. Ignition system fails analysis. b. Ignition system passes analysis.	a. Replace ignition components as required. b. Go to step 14.
14.	If not previously accomplished, perform MFP fuel pressure analysis.	a. Fuel system fails analysis. b. Fuel system passes analysis.	a. Replace MFP. b. Go to step 15.
15.	Perform start/leak functional check and check engine operation. Replace components in following order until engine operates properly: • MFC metering valve EHV • Generator stator • DEEC • MFC	a. Engine starts and b. operates properly. Engine does not start or operate properly.	a. Return engine to b. service. Replace next component and repeat step 15.

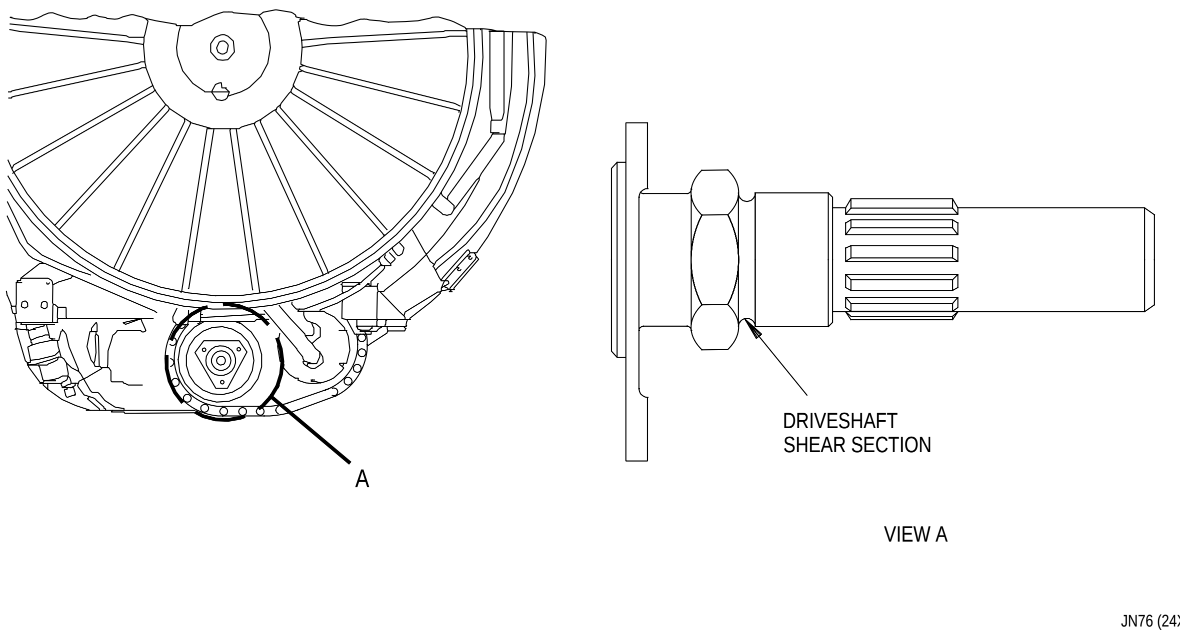


Figure 1. Starter Coupling Jaw - Inspection

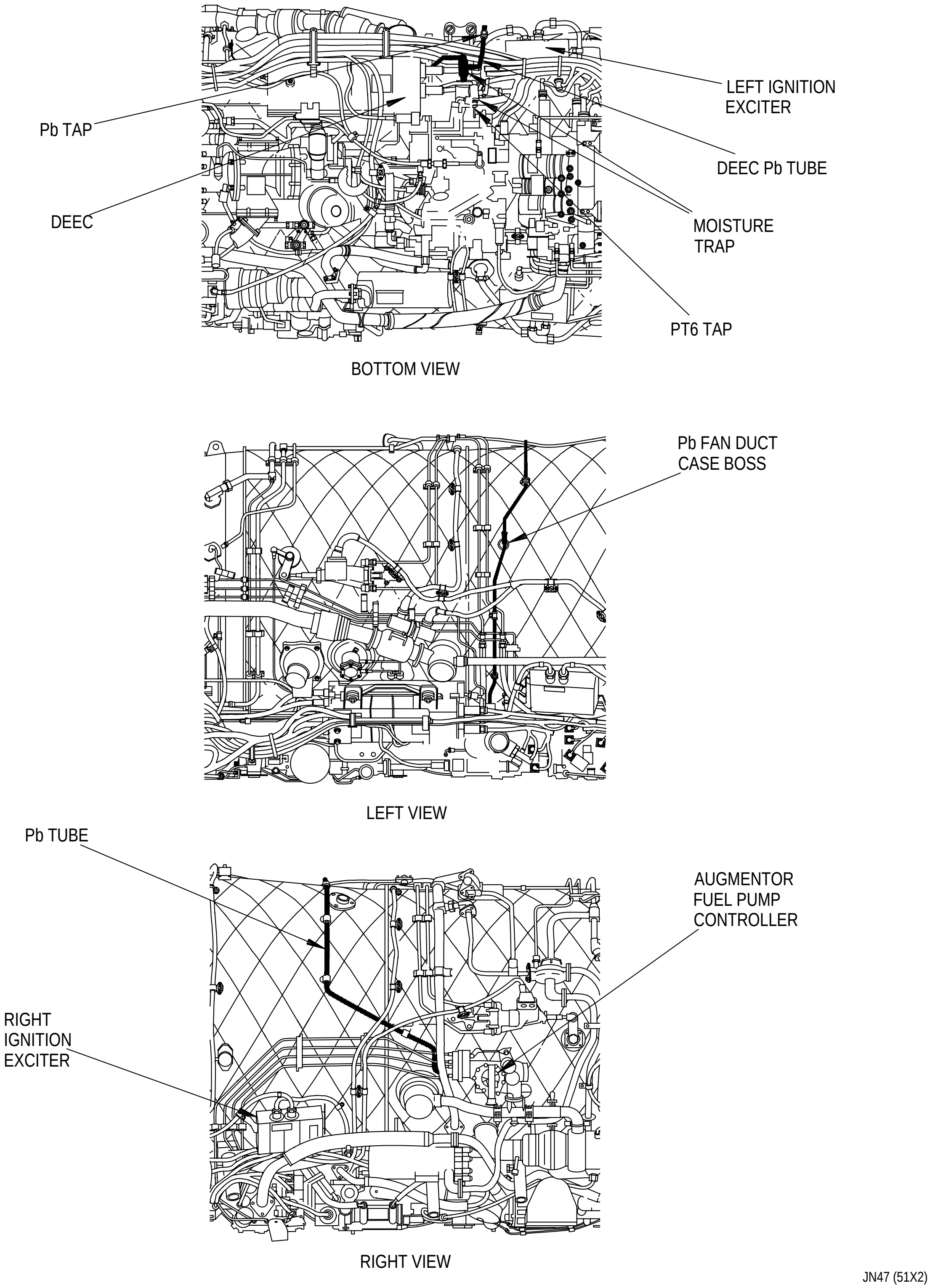
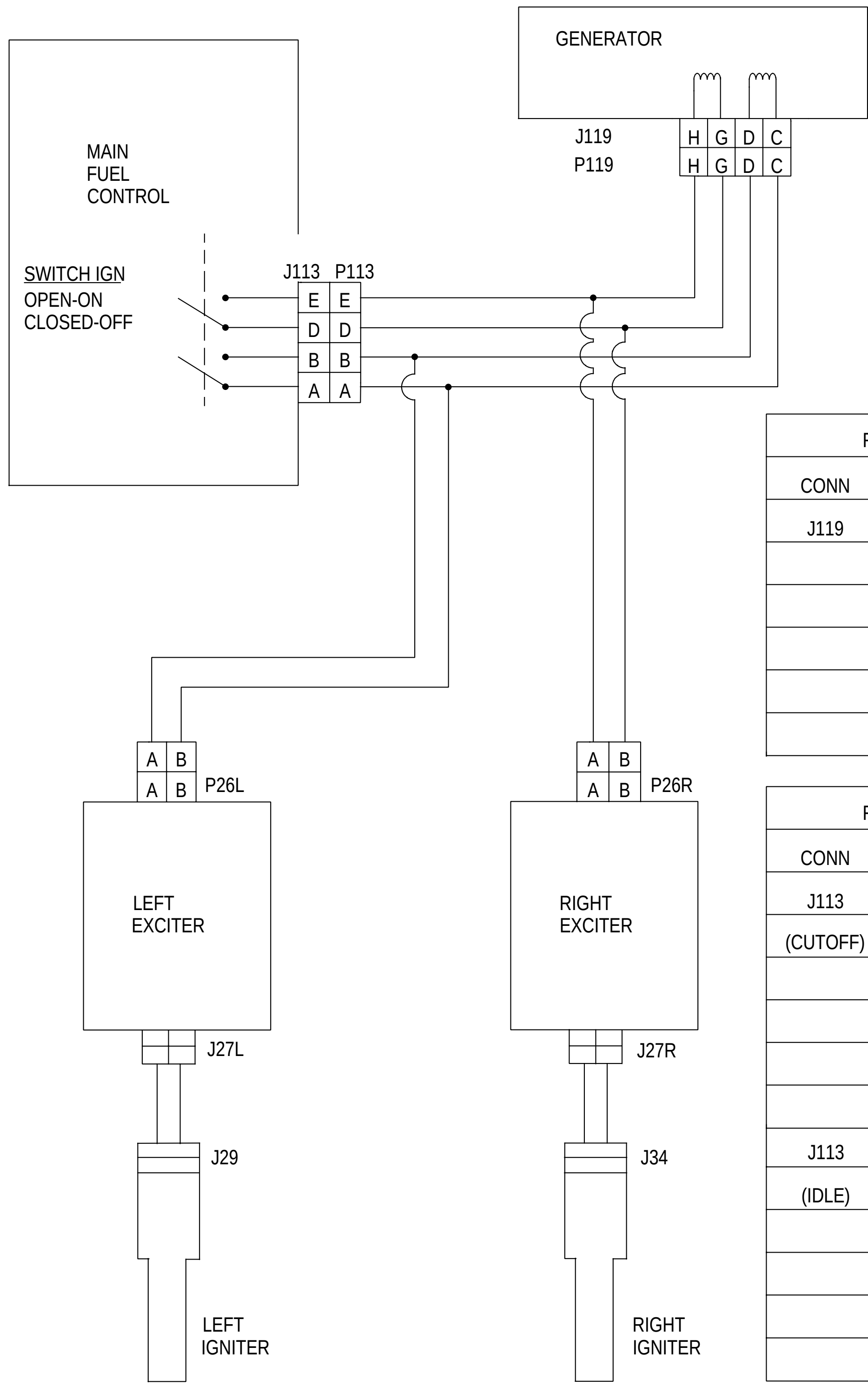


Figure 2. Pb Sense Line - Inspection



RESISTANCE LIMITS		
CONN	PINS	OHMS
J119	C-D	LT 10
	C-GND	GT 100,000
	D-GND	GT 100,000
	G-H	LT 10
	G-GND	GT 100,000
	H-GND	GT 100,000

RESISTANCE LIMITS		
CONN	PINS	OHMS
J113	C-D	LT 5
(CUTOFF)	A-GND	GT 100,000
	B-GND	GT 100,000
	D-E	LT 5
	D-GND	GT 100,000
	E-GND	GT 100,000
J113	A-B	GT 100,000
(IDLE)	A-GND	GT 100,000
	B-GND	GT 100,000
	D-E	GT 100,000
	D-GND	GT 100,000
	E-GND	GT 100,000

JN31X1 (51X2)

Figure 3. Gas Generator/MFC Ignition System Schematic (Resistance Checks)

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE INSTABILITY - PRIMARY MODE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	0				
6 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Start Procedures	WP 210 00
Engine Acceptance Test	WP 212 00
Idle Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Secondary Mode Anomaly	WP 523 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedures Using EAU	WP 652 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Augmentor Fuel System Analysis	WP 662 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for engine instability in primary mode.

2. ENGINE INSTABILITY - PRIMARY MODE.

(See Table 1.)

a. Description:

(1) Gas Generator Instability: Harmonic variation in engine operating values. Instability is considered out of limits when:

- N2 exceeds ±140 rpm
- N1 exceeds ±100 rpm
- FTIT exceeds ±18°F (±10°C)

(2) Gas generator instability is usually caused by noise in electrical circuits or contamination in hydromechanical circuits.

(3) Augmentor Instability: Harmonic variation in augmentor operation due to changes in fuel flow or exhaust nozzle position (ENP). Instability is considered out of limits when:

- ENP exceeds ±2%
- Fuel flow exceeds ±3000 pph

Table 1. Engine Instability - Primary Mode

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present. b. No events or faults present.	a. Troubleshoot individual event or fault codes. b. Go to step 2.
2.	Perform RCVV system actuation torque check.	a. RCVV system functions normally. b. RCVV system does not function normally.	a. Go to step 3. b. Repair as required.
3.	If ENP unstable, perform IDLE functional check.	a. Exhaust nozzle operates normally. b. Exhaust nozzle does not operate normally.	a. Go to step 4. b. Perform exhaust nozzle functional check. Repair as required.

NOTE

If instability occurred in augmentation, go to step 6.

Step	Procedure	Result	Corrective Action
4.	Start engine. Transfer engine to SECONDARY mode. Determine if instability exists with engine in Secondary mode.	a. No instability present. b. Instability still present.	a. Go to step 5. b. Troubleshoot SEC mode anomaly.
5.	Operate engine at unstable point in primary mode and check engine operation. Replace components in following order until engine operates properly. • MFC MV EHV • DEEC • MFC	a. No instability present. b. Instability still present	a. Return engine to service. b. Replace next component and repeat steps 4 and 5.

Table 1. Engine Instability - Primary Mode (continued)

Step	Procedure	Result	Corrective Action
6.	If instability occurred in augmentation, throttle to duplicate instability with EMSE in auto search mode. Check augmentor core and duct stream fuel flow request (words 69 and 72) for instability.	a. Core stream fuel flow request instability.	a. Replace AFC core metering valve EHV.
		b. Duct stream fuel flow request instability present.	b. Replace AFC duct metering valve EHV.
		c. No instability present.	c. Go to step 7.
7.	Perform augmentor fuel system analysis.	a. Fuel system passes analysis.	a. Replace component as required.
		b. Fuel system fails analysis.	b. Go to step 8.
8.	Operate engine at unstable point previously determined. Replace components in the following order until engine operates properly:	a. Engine operates properly.	a. Return engine to service.
	• AFPC • AFC	b. Engine does not operate properly.	b. Replace next component and repeat steps 7 and 8.

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE ANOMALY, IDLE TO INTERMEDIATE (MIL) - PRIMARY MODE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Final Dress (After Installation Into AF 8624151 Thrust Frame)	WP 102 00
Acceleration/Deceleration Checks	WP 213 00
Engine Troubleshooting - General	WP 501 00
Idle Speed Out of Limits	WP 514 00
Mn System Malfunction	WP 520 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedures Using EAU	WP 652 00
Main Fuel Pump Fuel Pressure Analysis	WP 661 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for engine anomaly, IDLE to Intermediate (MIL) (primary mode).

2. ENGINE ANOMALY, IDLE TO INTERMEDIATE (MIL) - PRIMARY MODE.

(See Table 1.)

a. Description:

(1) Off-Idle Stall: Engine stalls when throttle is snapped from IDLE position.

(2) Steady-State Stall: Engine stalls without throttle movement.

(3) Decel-Stall: Engine stalls when throttle is retarded.

(4) Auto-Accel: Engine accelerates without throttle advance or engine will not decelerate with throttle retarded. An engine stall may or may not accompany acceleration.

(5) Auto-Decel: Engine thrust decreases or rpm drops without throttle movement.

(6) Typically, an engine stall between IDLE and Intermediate (MIL) is caused by airflow anomaly such as RCVV misscheduling or compressor damage and deterioration or overscheduled fuel flow. Auto-Accels can be caused by excessive fuel scheduling, such as high metering valve differential pressure, or various electrical anomalies, which cause N2 and usually N1 and FTIT, to increase. A thrust loss can be caused by either the exhaust nozzle opening or by N2 rpm rollback (Auto-Decel) followed by N1 rpm and FTIT decrease.

Table 1. Engine Anomaly, IDLE to Intermediate (MIL) - Primary Mode

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Perform following gaspath inspections: a. Inspect fan inlet and turbine exhaust areas for damage or foreign objects.	a.1. No damage to inlet or exhaust areas.	a.1. Go to b.
		a.2. Damage to inlet or exhaust area.	a.2. Perform borescope inspection of entire gas generator (AP 1 through AP 7)
	b. Perform borescope inspection of core module (AP 2, 3, 4, and 7).	b.1. No core damage.	b.1. Go to step 3.
		b.2. Core damage.	b.2. Reject engine for teardown.
3.	Check throttle linkage: a. Ensure MFC PLA linkage secure and rotates smoothly.	a.1. PLA linkage serviceable.	a.1. Go to b.
		a.2. PLA linkage damaged.	a.2. Replace MFC.
	b. Check throttle rigging.	b.1. Throttle rigging within limits.	b.1. Go to step 4.
		b.2. Throttle rigging out of limits.	b.2. Rig throttle as required.

Table 1. Engine Anomaly, IDLE to Intermediate (MIL) - Primary Mode (continued)

Step	Procedure	Result	Corrective Action
4.	Perform RCVV system actuation torque check.	a. RCVV system functions properly.	a. Go to step 5.
		b. RCVV system does not function properly.	b. Repair RCVV system as required.
5.	Perform MFP pressure analysis.	a. Fuel pressures within limits.	a. Go to step 6.
		b. Fuel pressures out of limits.	b. Replace MFP.
6.	Start engine. Stabilize at IDLE 5 minutes. Check IDLE N1C2 rpm.	a. IDLE N1C2 4200 to 4400 rpm.	a. Go to step 7.
		b. IDLE N1C2 rpm out of limits.	b. Troubleshoot IDLE N1C2 out of limits.
7.	Snap throttle to Intermediate (MIL). Check Pfo between IDLE and Intermediate (MIL).	a. Pfo within limits.	a. Go to step 8.
		b. Pfo out of limits.	b. Check the following: 1. Test cell fuel pump switches ON. 2. Fuel shut-off valve fully open. 3. Test cell fuel supply adequate.

Table 1. Engine Anomaly, IDLE to Intermediate (MIL) - Primary Mode (continued)

Step	Procedure	Result	Corrective Action
8.	If anomaly occurred at Mn greater than 9, perform Mn IDLE lockout check.		
	a. Move throttle to Intermediate (MIL), then increase Mn output to 1071 Octal. Note N1 rpm.	a.1. EMSE Mn within limits.	a.1. Go to b.
		a.2. EMSE Mn out of limits.	a.2. Repair or replace Mn simulator.
	b. Move throttle to IDLE. Note N1 rpm.	b.1. N1 rpm (with throttle at IDLE) within 100 rpm of Intermediate (MIL) rpm.	b.1. Go to c.
		b.2. N1 rpm out of limits.	b.2. Troubleshoot Mn system malfunction.
	c. Decrease Mn Octal output to 0214.	c.1. Engine decelerates normally.	c.1. Go to step 9.
		c.2. Engine does not decelerate normally.	c.2. Troubleshoot Mn system malfunction.
9.	Perform accel/decel functional check and check engine operation. Replace components in following order until engine operates properly:	a. Anomaly does not repeat.	a. Return engine to service.
	• DEEC • MFC • Core module (for Off-IDLE stalls only)	b. Anomaly repeats.	b. Replace next component and repeat step 9.

WORK PACKAGE

TECHNICAL PROCEDURES

AUGMENTOR ANOMALIES

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 18

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 17	0				
18 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Acceleration/Deceleration Checks	WP 213 00
Engine Troubleshooting - General	WP 501 00
EPR vs. N1C2 Out of Limits, Intermediate (MIL) -Primary Mode	WP 515 00
Ignition System Anomaly	WP 518 00
EDU Test Procedures	WP 650 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedures Using EAU	WP 652 00
Augmentor Fuel System Analysis	WP 662 00
Ignition System Analysis	WP 664 00
DEEC Pressure Sensing System Analysis	WP 675 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Igniter - Spark, Gas Turbine Engine Augmentor	WP 025 00
Detector, Augmentor Light-off	WP 041 00
Augmentor Spray Manifold	TBD

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Augmentor Anomaly	
	Ohmmeter	PSM-6 or equivalent
3	Augmentor Blowout	
	Ohmmeter	PMS-6 or equivalent
4	Augmentor No-Light	
	Ohmmeter	PMS-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for augmentor anomalies.

2. AUGMENTOR ANOMALIES.

(See Figures 1 and 2, and Table 1.)

a. Description:

NOTE

EDU will not record augmentor anomalies less than 3.6 psia Pt2C.

(1) Augmentor Blowout: Sudden termination of normal augmentor combustion usually caused by initiation or sequencing fan stall or by augmentor rumble.

(2) Fan Stall In Augmentation: A flow instability in the fan usually caused by an augmentor blowout and auto-relight, or improper light-off or sequencing due to excessive augmentor fuel flow.

(3) Augmentor Rumble: High frequency combustion instability caused by excessive fuel/air ratio.

(4) Augmentor No-Light: Engine sequences to augmentor (exhaust nozzle opens slightly), but combustion does not occur due to lack of ignition or fuel. Light-Off Detector (LOD), if functional, will prevent further sequencing.

(5) No Augmentation: Engine will not advance into augmentation due to a control system fault.

•

Table 1. Augmentor Anomalies

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. 1000 through 4999 fault codes are present.	a. Troubleshoot event or fault codes.
		b. 5000 thru 5002 Advisory Fault codes present	b. Go to step 2.
		c. No events or faults are present.	c. Go to step 2.
2.	Review EDU Advisory Fault Codes 5000 - 5002.	a. Advisory Fault Code 5000 present.	a. Go to step 4.
		b. Advisory Fault Code 5001 present.	b. Troubleshoot anomaly per table 2.
		c. Advisory Fault Code 5002 present.	c. Troubleshoot anomaly per table 3.
3.	deleted		
4.	Visually inspect augmentor area for damage:	a. No damaged parts.	a. Go to step 5.
	• Flameholder • Flameholder Gap (especially between nosepiece and inner and outer shrouds within 2 inches of igniters) • Sprayrings (especially Segment 1 shield, brackets, and ignition orifices at igniters) • Igniters (burning/buckling) • LOD lens	b. Damaged parts.	b. Repair or replace parts as required.
5.	Check security of LOD mounting and electrical cable connector.	a. LOD secure.	a. Go to step 6.
		b. LOD loose.	b. Repair LOD as required.
6.	Determine when augmentor anomaly occurred.	a. Anomaly occurred during augmentor sequencing (augmentor lit)	a. Record segment if known. Go to step 15.
		b. Anomaly occurred at augmentor initiation (no flame), or unknown.	b. Go to step 7.

Table 1. Augmentor Anomalies (continued)

Step	Procedure	Result	Corrective Action
7.	Visually inspect generator stator for: • Loose mounting • Cracked housing • Loose connectors • Contamination or arcing inside connectors.	a. Generator serviceable. b. Generator damaged.	a. Go to step 8. b. Clean connectors as required. Otherwise, repair or replace generator stator or ignition cable.
8.	Check generator stator ignition circuits. Perform following resistance checks. See figure 1. a. CONN J119 PINS 1. E to F 2. E to GND 3. F to GND 4. J to K 5. J to GND 6. K to GND	a.1 Resistance checks within limits: 1. LT 25 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 25 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS a.2 Resistance checks out of limits.	a.1. Go to step 9. a.2. Replace generator stator.
9.	Check AFC fill switch and ignition relay circuit. Perform following resistance checks. See figure 2. a. CONN P84 PINS 1. CC to AA 2. DD to AA 3. C to AA 4. d to AA	a.1 Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS a.2 Resistance checks out of limits.	a.1. Go to b. a.2. Replace AFC cable.

Table 1. Augmentor Anomalies (continued)

Step	Procedure	Result	Corrective Action
9. (cont)	b. CONN P84 PINS 1. CC to DD 2. CC to GND 3. DD to GND 4. d to C 5. d to GND 6. C to GND	b.1. Resistance checks within limits: 1. 200 to 400 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Go to step 10.
		b.2. Resistance checks out of limits.	b.2. Disconnect P97 from AFC fill switch and ignition relay module. Go to c.
	c. CONN J97 PINS 1. A to B 2. A to GND 3. B to GND 4. C to D 5. C to GND 6. D to GND	c.1. Resistance checks within limits: 1. 200 to 400 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	c.1. Replace AFC cable.
		c.2. Resistance checks out of limits.	c.2. Replace AFC fill switch and ignition relay module.
10.	Check AFC ignition switch circuits. Perform following resistance checks. See figure 1. CONN J104 PINS 1. A to B 2. A to GND 3. B to GND 4. D to E 5. D to GND 6. E to GND	a. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	a. Go to step 11.
		b. Resistance checks out of limits.	b. Replace fill switch and ignition relay module.
11.	Perform augmentor ignition system functional check.	a. Augmentor operates normally.	a. Go to step 12.
		b. Augmentor does not operate normally.	b. Troubleshoot augmentor ignition anomaly.

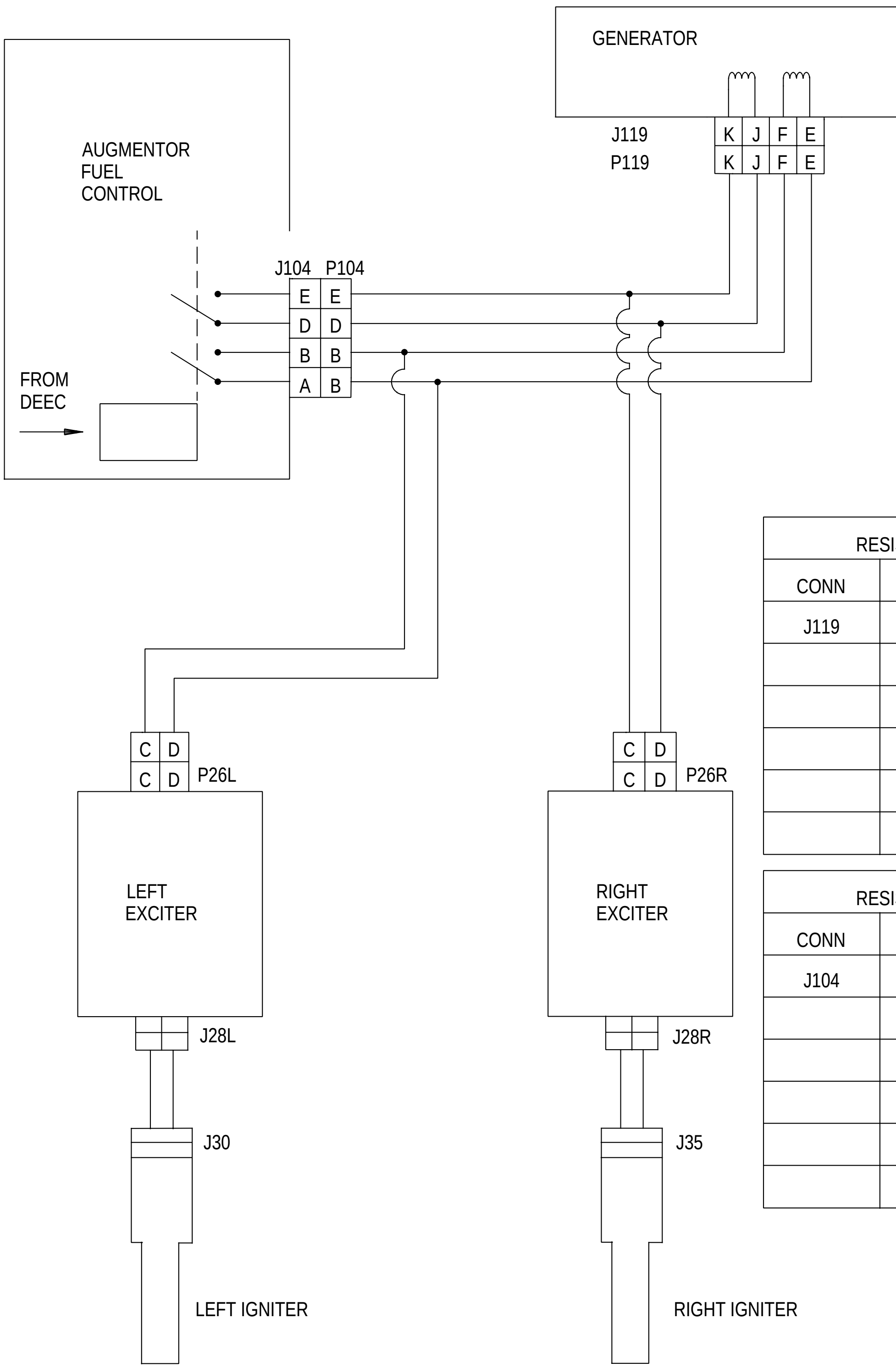
Table 1. Augmentor Anomalies (continued)

Step	Procedure	Result	Corrective Action
12.	Perform DEEC pressure sensing system analysis.	a. Pressure system fails analysis.	a. Repair or replace system components as required and go to step 13.
		b. Pressure system passes analysis.	b. Go to step 13.
13.	Run engine at IDLE. Cycle Idle Exhaust Nozzle switch: RESET - OFF - RESET.	a. Exhaust nozzle operates normally.	a. Go to step 14.
		b. Exhaust nozzle does not operate normally.	b. Remove primary flex shafts from exhaust nozzle actuator and CENC. Perform exhaust nozzle functional check.

CAUTION

Engine bleed air manifolds and tubing are hot. Do not touch these areas while checking for air leaks.

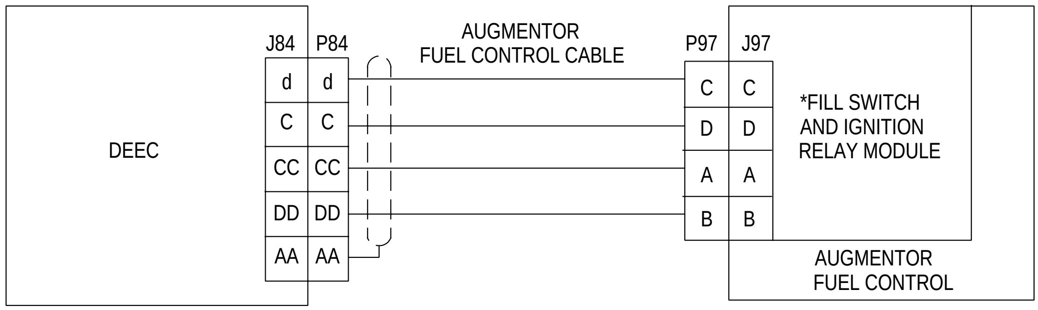
Step	Procedure	Result	Corrective Action
14.	Check 13th stage bleed, anti-ice, CENC, and AFP air tubes for leaks.	a. No leaks.	a. Go to step 15.
		b. Leaks.	b. Repair leaks as required, and go to step 16.
15.	Perform augmentor fuel system pressure analysis.	a. Fuel pressure within limits.	a. Go to step 16.
		b. Fuel pressure out of limits.	b. Repair or replace components as required.
16.	Perform snap acceleration/ deceleration functional check and check augmentor operation. Replace components in following order until augmentor operates normally:	a. Augmentor operates normally.	a. Return engine to service.
	• DEEC • AFC • Augmentor sprayrings (Replace manifold in which anomaly occurred. See step 7.)	b. Augmentor does not operate normally.	b. Replace next component and repeat step 16.



RESISTANCE LIMITS		
CONN	PINS	OHMS
J119	E-F	LT 25
	E-GND	GT 100,000
	F-GND	GT 100,000
	J-K	LT 25
	J-GND	GT 100,000
	K-GND	GT 100,000

RESISTANCE LIMITS		
CONN	PINS	OHMS
J104	A-B	LT 5
	A-GND	GT 100,000
	B-GND	GT 100,000
	D-E	LT 5
	D-GND	GT 100,000
	E-GND	GT 100,000

Figure 1. Augmentor Ignition System Schematic - Generator Stator and AFC Ignition Switch Resistance Checks



*FILL SWITCH NORMALLY CLOSED. SWITCH OPENS DURING AUGMENTOR QUICKFILL FOR EACH OF THE ELEVEN SEGMENTS.

FILL SWITCH RESISTANCE LIMITS		
PINS P84	PINS J97	OHMS
CC-DD	A-B	200-400
CC-GND	A-GND	GT 100,000
DD-GND	B-GND	GT 100,000
d-C	C-D	LT 5
d-GND	C-GND	GT 100,000
C-GND	D-GND	GT 100,000
CC-AA		GT 100,000
DD-AA		GT 100,000
C-AA		GT 100,000
d-AA		GT 100,000

JN34 (24X2)

Figure 2. Augmentor Fuel Control Fill Switch and Ignition Relay Circuit

3. AUGMENTOR BLOWOUT

(See figure 2, and Table 2.)

a. Description:

NOTE

EDU will not record augmentor anomalies less than 3.6 psia Pt2C.

(1) Augmentor Blowout: Sudden termination of normal augmentor combustion usually caused by initiation or sequencing fan stall or augmentor rumble.

Table 2. Augmentor Blowout

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present. b. No events or faults present.	a. Troubleshoot individual event or fault codes. b. Go to step 3.
2.	deleted		
3.	Visually inspect augmentor area for damage: • Flameholder • Sprayrings (especially Segment 1 shield, brackets, and ignition orifices at igniters) • LOD lens	a. Parts within limits. b. Parts out of limits.	a. Go to step 4. b. Repair or replace parts as required.
4.	Check security of LOD mounting and electrical cable connector.	a. LOD secure. b. LOD loose.	a. Go to step 5. b. Repair LOD as required.
5.	Determine when augmentor blowout occurred.	a. Blowout occurred during augmentor sequencing (augmentor lit).	a. Record blowout segment, if known. Go to step 9.

Table 2. Augmentor Blowout (continued)

Step	Procedure	Result	Corrective Action
6.	Check AFC fill switch and ignition relay circuit. Perform the following resistance checks. See figure 2.		
	a. CONN P84 — PINS 1. CC to AA 2. DD to AA 3. C to AA 4. d to AA	a.1 Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	a.1. Go to b.
		a.2 Resistance checks out of limits.	a.2. Replace AFC cable.
	b. CONN P84 — PINS 1. CC to DD 2. CC to GND 3. DD to GND 4. d to C 5. d to GND 6. C to GND	b.1 Resistance checks within limits: 1. 200 to 400 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Go to step 7.
		b.2 Resistance checks out of limits.	b.2. Disconnect P97 from fill switch and ignition relay module. Go to c.
	c. CONN J97 — PINS 1. A to B 2. A to GND 3. B to GND 4. C to D 5. C to GND 6. D to GND	c.1 Resistance checks within limits: 1. 200 to 400 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	c.1. Replace AFC cable.
		c.2 Resistance checks out of limits.	c.2. Replace AFC fill switch and ignition relay module.

Table 2. Augmentor Blowout (continued)

Step	Procedure	Result	Corrective Action
7.	Perform DEEC pressure sensing system analysis.	a. Pressure system passes analysis.	a. Repair or replace components as necessary, and go to step 8.
		b Pressure system fails analysis.	b. Go to step 8.
8.	Run engine at IDLE. Cycle IDLE Exhaust Nozzle switch: RESET-OFF-RESET.	a. Exhaust nozzle operates normally.	a. Go to step 9.
		b. Exhaust nozzle does not operate normally.	b. Disconnect primary flex shafts from exhaust nozzle actuator and CENC. Perform exhaust nozzle functional check.

WARNING

Engine bleed air manifolds and tubing are hot. Do not touch these areas while checking for air leaks.

Step	Procedure	Result	Corrective Action
9.	Check 13th stage bleed, anti-ice, CENC, and AFP air tubes for leaks.	a. No leaks.	a. Go to step 10.
		b. Leaks.	b. Repair leaks as required, and go to step 10.
10.	Perform augmentor fuel system pressure analysis.	a. Fuel pressure within limits.	a. Go to step 11.
		b. Fuel pressure out of limits.	b. Repair or replace components as required.
11.	Perform snap acceleration/deceleration functional check and check augmentor operation. Replace components in following order until augmentor operates normally:	a. Augmentor operate normally.	a. Return engine to service.
	• LOD • DEEC • AFC • Augmentor Sprayring (Replace manifold in which blowout occurred. See step 6.)	b. Augmentor does not operate normally.	b. Replace next component and repeat step 10 and 11.

4. AUGMENTOR NO-LIGHT.

(See Figures 1 and 2, and Table 3.)

a. Description:

NOTE

EDU will not record augmentor anomalies less than 3.6 psia Pt2C.

(1) Augmentor No-Light: Engine sequences to augmentor (exhaust nozzle opens slightly), but combustion does not occur due to lack of ignition or fuel. Light-Off Detector (LOD), if functional, will prevent further sequencing.

(2) No Augmentation: Engine will not advance into augmentation due to a control system fault.

Table 3. Augmentor No-Light

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	If not previously accomplished, perform EDU test.	a. EDU fails test.	a. Replace EDU. Go to step 3.
		b. EDU passes test.	b. Go to step 3.
3.	Visually inspect augmentor area for damage:	a. Parts within limits.	a. Go to step 4.
		b. Parts out of limits.	b. Repair or replace parts as required.
	• Flameholder • Flameholder Gap (especially between nosepiece and inner and outer shrouds within 2 inches of igniters) • Sprayrings (especially Segment 1 shield, brackets, and ignition orifices at igniters) • Igniters (burning/buckling) • LOD lens		
4.	Check security of LOD mounting and electrical cable connector.	a. LOD secure.	a. Go to step 5.
		b. LOD loose.	b. Repair LOD as required.
5.	Visually inspect generator stator for:	a. Generator serviceable.	a. Go to step 6.
	• Loose mounting • Cracked housing • Loose connectors • Contamination or arcing inside connectors	b. Generator damaged.	b. Clean connectors as required. Otherwise, repair or replace generator stator or ignition cable.

Table 3. Augmentor No-Light (continued)

Step	Procedure	Result	Corrective Action
6.	Check generator stator ignition circuits. Perform the following resistance checks. See figure 1.		
	CONN J119 PINS	a. Resistance checks within limits:	a. Go to step 7.
	1. E to F	1. LT 25 OHMS	
	2. E to GND	2. GT 100,000 OHMS	
	3. F to GND	3. GT 100,000 OHMS	
	4. J to K	4. LT 25 OHMS	
	5. J to GND	5. GT 100,000 OHMS	
	6. K to GND	6. GT 100,000 OHMS	
		b. Resistance checks out of limits.	b. Replace generator.
7.	Check AFC fill switch and ignition relay circuit. Perform the following resistance checks. See figure 2.		
	a. CONN P84 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	1. CC to AA	1. GT 100,000 OHMS	
	2. DD to AA	2. GT 100,000 OHMS	
	3. C to AA	3. GT 100,000 OHMS	
	4. d to AA	4. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace AFC cable.
	b. CONN P84 PINS	b.1. Resistance checks within limits:	b.1. Go to step 8.
	1. CC to DD	1. 200 to 400 OHMS	
	2. CC to GND	2. GT 100,000 OHMS	
	3. DD to GND	3. GT 100,000 OHMS	
	4. d to C	4. LT 5 OHMS	
	5. d to GND	5. GT 100,000 OHMS	
	6. C to GND	6. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Disconnect P97 from fill switch and ignition relay module. Go to c.

Table 3. Augmentor No-Light (continued)

Step	Procedure	Result	Corrective Action
7. (cont)	c. CONN J97 PINS 1. A to B 2. A to GND 3. B to GND 4. C to D 5. C to GND 6. D to GND	c.1. Resistance checks within limits: 1. 200 to 400 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	c.1. Replace AFC cable.
		c.2. Resistance checks out of limits.	c.2. Replace AFC fill switch and ignition relay module.
8.	Check AFC ignition switch circuits. Perform following resistance checks. See figure 1.		
	CONN J104 PINS 1. A to B 2. A to GND 3. B to GND 4. D to E 5. D to GND 6. E to GND	a. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	a. Go to step 9.
		b. Resistance checks out of limits.	b. Replace fill switch and ignition relay module.
9.	Perform augmentor ignition system functional check.	a. Augmentor operates normally.	a. Go to step 10.
		b. Augmentor does not operate normally.	b. Troubleshoot augmentor ignition anomaly.
10.	Perform augmentor fuel system pressure analysis.	a. Fuel pressure within limits.	a. Go to step 11.
		b. Fuel pressure out of limits.	b. Repair or replace components as required.
11.	Perform snap acceleration/deceleration functional check and check augmentor operation. Replace components in following order until augmentor operates normally: • DEEC • AFC • Generator stator • Augmentor Segment 1 sprayring	a. Augmentor operates normally.	a. Return engine to service.
		b. Augmentor does not operate normally.	b. Replace next component and repeat step 12.

WORK PACKAGE

TECHNICAL PROCEDURES

EXHAUST NOZZLE POSITION OUT OF LIMITS - PRIMARY MODE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 7	0				
8 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Start Procedures	WP 210 00
Engine Troubleshooting - General	WP 501 00
System Fault Codes 4080 - 4083: N1 System	WP 608 00
System Fault Codes 4100 - 4102: Tt2 System	WP 610 00
System Fault Code 4110: MFC PLA System	WP 611 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Nozzle - Convergent Actuation System, Integrity Check	WP 040 00
Rigging Check and Rigging Convergent Exhaust Nozzle Control System	WP 103 00
Augmentor Duct and Nozzle Module	T.O. 2J-F100-53-10
Inspection	WP 300 00
Nozzle Segment, Divergent, Augmentor - Inspection	WP 314 00
Assembly	WP 701 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	ENP Out of Limits - Primary Mode	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for ENP out of limits in primary mode.

2. ENP OUT OF LIMITS - PRIMARY MODE.

(See Figure 1, and Table 1.)

a. Description

(1) In primary mode, ENP should be 81 to 89% at IDLE and less than 35% at Intermediate (MIL).

Table 1. ENP Out Of Limits - PRIMARY MODE

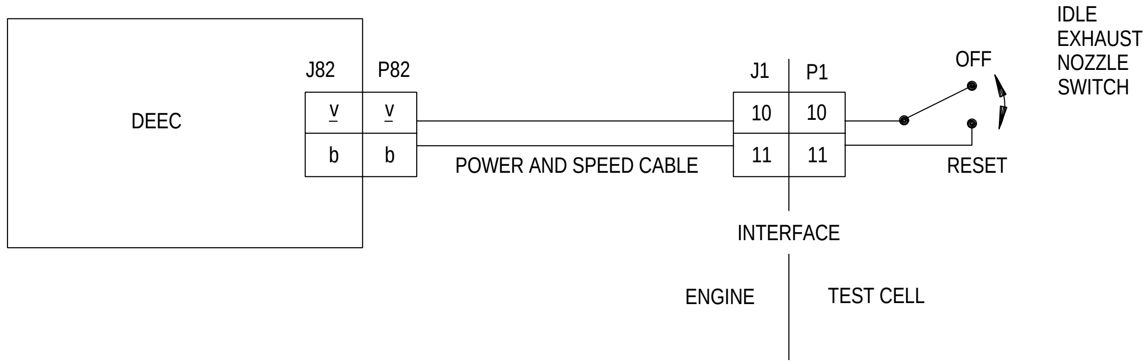
Step	Procedure	Result	Corrective Action
1.	Visually inspect exhaust nozzle:	a. Exhaust nozzle parts within limits.	a. Go to step 2.
		b. Exhaust nozzle parts out of limits.	b. Replace exhaust nozzle.
2.	Check exhaust nozzle rigging.	a. Exhaust nozzle rigged properly.	a. Go to step 3.
		b. Exhaust nozzle out of rig.	b. Rig exhaust nozzle.
3.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 4.
4.	Perform Primary Mode engine start. With throttle at IDLE, idle Exhaust Nozzle cycle switch to RESET-OFF-RESET, and note ENP response.	a. Exhaust nozzle operates normally.	a. Go to step 6.
		b. Exhaust nozzle does not operate normally.	b. Disconnect primary flex shafts from exhaust nozzle actuators and CENC. Perform exhaust nozzle functional checks.
		c. Exhaust nozzle does not move.	c. Go to step 5.

Table 1. ENP Out Of Limits
PRIMARY MODE (continued)

Step	Procedure	Result	Corrective Action
5.	Shut down engine and check Exhaust Nozzle Reset circuit. See figure 1.		
	a. CONN P82 PINS	a.1. Resistance checks within limits:	a.1. Go to step 6.
	SWITCH-OFF		
	1. v to b 2. v to GND 3. b to GND	1. GT 100,000 OHMS GT 2. 100,000 OHMS GT 3. 100,000 OHMS	
	SWITCH-RESET		
	4. v to b 5. v to GND 6. b to GND	4. LT 5 OHMS GT 5. 100,000 OHMS GT 6. 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Disconnect J1 from engine. Go to b.
	b. CONN P1 PINS	b.1. Resistance checks within limits:	b.1. Replace power and speed cable.
	SWITCH-OFF		
	1. 10 to 11 2. 10 to GND 3. 11 to GND	1. GT 100,000 OHMS GT 2. 100,000 OHMS GT 3. 100,000 OHMS	
	SWITCH-RESET		
	4. 10 to 11 10 to GND 5. 11 to GND 6.	4. LT 5 OHMS GT 5. 100,000 OHMS GT 6. 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Repair test cell wiring connected to Exhaust Nozzle Reset switch.

Table 1. ENP Out Of Limits PRIMARY MODE (continued)

Step	Procedure	Result	Corrective Action
6.	Operate engine at power setting where ENP is out of limits with EMSE in auto search mode. Check following parameters:		
	a. DEEC Aj request (word 61)	a.1. Aj request 81 to 89% at IDLE or less than 35% at Intermediate (MIL).	a.1. Go to step 7.
		a.2. Aj request out of limits.	a.2. Go to b.
	b. Compare EMSE N1 value (word 28) to test cell N1 rpm.	b.1. EMSE N1 value within 50 rpm of test cell valve.	b.1. Go to c.
		b.2. EMSE N1 value out of limits.	b.2. Troubleshoot System Fault Code 4081.
	c. Compare EMSE Tt2 signals (words 52 and 53) to test cell Tt2 value.	c.1. EMSE Tt2 values within 18°F (10°C) of test cell Tt2.	c.1. Go to d.
		c.2. EMSE Tt2 values out of limits.	c.2. Troubleshoot System Fault Code 4102.
	d. DEEC PLA (word 24).	d.1. EMSE PLA value 14 to 19° at IDLE or 83 to 89° at Intermediate (MIL).	d.1. Go to step 7.
		d.2. EMSE PLA value out of limits.	d.2. Troubleshoot System Fault Code 4112.
7.	Perform exhaust nozzle functional check and check engine operation. Replace components in following order until engine operates properly:	a. ENP within limits.	a. Return engine to service.
	•DEEC •CENC EHV •CENC	b. ENP out of limits.	b. Replace next component and repeat steps 6 and 7.



IDLE EXHAUST NOZZLE SWITCH CIRCUIT LIMITS			
SWITCH POSITION	P82	P1	OHMS
OFF	v-b	10-11	GT 100,000
	v-GND	10-GND	GT 100,000
	b-GND	11-GND	GT 100,000
RESET	v-b	10-11	LT 5
	v-GND	10-GND	GT 100,000
	b-GND	11-GND	GT 100,000

JN35 (30X2)

Figure 1. Exhaust Nozzle Reset Circuit Schematic

WORK PACKAGE

TECHNICAL PROCEDURES

IDLE SPEED OUT OF LIMITS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

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REFERENCE MATERIAL REQUIRED

None

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for IDLE speed out of limits.

2. IDLE SPEED OUT OF LIMITS.

(See Table 1.)

a. Description:

(1) The DEEC sets IDLE speed by adjusting MFC metering valve EHV to maintain a constant N_1C_2 rpm biased by Mn. For Approach, IDLE speed is 4025 to 4225 N_1C_2 rpm (F-16) and 4675 to 4875 N_1C_2 rpm (F-15). On ground, with Mn defaulted to 0.15, IDLE speed is 4025 to 4225 N_1C_2 rpm.

(2) A constant N_1C_2 rpm, combined with a fixed exhaust nozzle position switch RESET, provides a constant ground thrust for safe aircraft taxi speeds.

Table 1. Idle Speed Out Of Limits

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Check throttle rigging.	a. Throttle rigged properly.	a. Go to step 3.
		b. Throttle out of rig.	b. Rig throttle.
3.	Check instrumentation:		
	a. Compare test cell N1 and Tt2 instrumentation to EMSE: • N1 • Tt2	a.1. N1 within ±50 rpm Tt2 within ±5°C (±9°F).	a.1. Go to b.
		a.2. N1 and/or Tt2 out of limits.	a.2.a. Check N1 and Tt2 instrumentation calibration. If test cell calibrations within limits, go to b and c.
			a.2.b. If N1 value is out of limits, troubleshoot System Fault Code 4083.
			a.2.c. If Tt2 value out of limits, troubleshoot System Fault Code 4102.
	b. Compare Tt2A vs Tt2B individual circuit inputs using EMSE.	b.1. Individual Tt2 circuit values within ±3°C (±5°F).	b.1. Go to step 4.
		b.2. Individual circuit values out of limits.	b.2. If Tt2 value is out of limits, troubleshoot System Fault Code 4102.

Table 1. Idle Speed Out Of Limits (continued)

Step	Procedure	Result	Corrective Action
4.	With engine at IDLE, manually calculate N1C2.	a. N1C2 value within ±50 rpm. b. N1C2 value out of limits.	a. Go to step 5. b. Recalibrate or replace standard day box.
5.	With engine at IDLE, check Mn signal using EMSE.	a. EMSE Mn value 0.13 to 0.17. b. EMSE Mn value out of limits.	a. Go to step 6. b. Troubleshoot Mn system anomaly.
6.	With engine at IDLE, check PLA resolver signal using EMSE.	a. EMSE PLA value less than 19 degrees. b. EMSE PLA value out of limits.	a. Go to step 7. b. Troubleshoot System Fault Code 4112.
7.	With engine at IDLE, check N1C2 requested by DEEC using EMSE.	a. EMSE N1C2 requested value 4025 to 4225 rpm. b. EMSE N1C2 requested value out of limits.	a. Go to step 8. b. Replace DEEC.
8.	Operate engine at IDLE and check N1C2 rpm. Replace components in the following order until engine operates properly: • DEEC • MFC	a. IDLE N1C2 rpm within limits. b. IDLE N1C2 rpm out of limits.	a. Return engine to service. b. Replace the next component and repeat steps 7 and 8.

WORK PACKAGE

TECHNICAL PROCEDURES

EPR vs. N1C2 OUT OF LIMITS, INTERMEDIATE (MIL) - PRIMARY MODE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
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REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Final Dress (After Installation Into AF 8624151 Thrust Frame)	WP 102 00
Introduction Testing Procedures	WP 200 00
Engine Acceptance Test	WP 212 00
Engine Troubleshooting - General	WP 501 00
Anti-Ice System Malfunction	WP 517 00
System Fault Codes 4080 - 4083: N1 System	WP 608 00
System Fault Codes 4100 - 4102: Tt2 System	WP 610 00
DEEC Test Procedures Using EAU	WP 652 00
Downloading and Reviewing Data Using CEDS	WP 657 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Compressor Bleed System Function Check	WP 667 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Cylinder Actuating, Linear, Variable Vane, Compressor Inlet	WP 037 00
Cylinder, Actuating, Linear, Compressor Bleed	WP 038 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for EPR vs. N1C2 out of limits, Intermediate (MIL) in PRIMARY mode with no faults detected.

2. EPR vs. N1C2 OUT OF LIMITS, INTERMEDIATE (MIL) - PRIMARY MODE.

(See Figure 1 and Table 1.)

a. Description:

(1) EPR vs. N1C2 point is out of limits: performance deterioration can be caused by control misscheduling of MFC fuel flow, CIVVs, RCVVs, exhaust nozzle position out of limits, or deterioration within the engine gas generator section.

Table 1. N1C2 Out Of Limits, Intermediate (MIL) - PRIMARY MODE

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Inspect fan inlet and turbine exhaust areas for damage or foreign objects.	a. No damage or foreign objects.	a. Go to step 3.
		b. Damage or foreign objects.	b. Perform complete borescope inspection.
3.	Check throttle linkage: a. Ensure MFC PLA linkage is secure and rotates smoothly.	a.1. MFC PLA linkage serviceable.	a.1. Go to b.
		a.2. MFC PLA linkage damaged.	a.2. Replace MFC.
	b. Check throttle rigging.	b.1. Throttle rigging within limits.	b.1. Go to step 4.
		b.2. Throttle rigging out of limits.	b.2. Rig throttle as required.
4.	Visually inspect all borescope locations for missing plugs.	a. All borescope plugs installed.	a. Go to step 5.
		b. Borescope plugs missing.	b. Check for heat damage. Replace missing borescope plug.

Table 1. N1C2 Out Of Limits, Intermediate (MIL) - PRIMARY MODE (continued)

Step	Procedure	Results	Corrective Action
5.	Compare test cell instrumentation to DEEC values: 1. N1 (Word 28) 2. Tt2 (Word 54)	a. Instrumentation within limits: 1. N1 within ±9°F (±5°C) 2. Tt2 within ±9°F (±5°C)	a. Go to step 7.
		b. Instrumentation out of limits.	b.1. Check test cell calibration. b.2. If N1 still out of limits, troubleshoot System Fault Code 4083. b.3. If Tt2 still out of limits, troubleshoot System Fault Code 4102.
6.	Perform DEEC pressure sensing system analysis.	a. System passes analysis	a. Go to step 7.
		b. System does not pass analysis.	b. Replace system parts as required.

Table 1. N1C2 Out Of Limits, Intermediate (MIL) - PRIMARY MODE (continued)

Step	Procedure	Result	Corrective Action
	WARNING Engine bleed air manifolds and tubing are hot. Do not touch these areas while checking for air leaks.		
7.	Check for air leaks. Run engine between IDLE and partial power (approximately 11,200 N2 rpm). See figure 1.		
	a. Check for air leaks at:	a.1. No air leaks present.	a.1. Go to b.
	• Borescope ports • Anti-ice valve and tubing • 13th stage bleed ports • AFP air supply manifold • CENC air supply tube	a.2. Air leaks present.	a.2. Shut down engine and repair or replace parts as required.
	b. Ensure engine ANTI-ICE valve switch is off, and engine is at IDLE. Check anti-ice air manifolds for temperature.	b.1. Air manifold temperature close to ambient.	b.1. Go to c.
		b.2. Air manifolds hot (TAI greater than 216°F (120°C)).	b.2. Troubleshoot anti-ice system.
	c. Check bleed strap actuator rigging.	c.1. Bleed strap actuator out of rig.	c.1. Rig actuator. Go to step 8.
		c.2. Bleed strap actuator in rig.	c.2. Go to step 8.
8.	If not previously accomplished, perform RCVV/CIVV schedule check.	a. RCVV/CIVV position within limits.	a. Go to step 9.
		b. RCVV/CIVV position out of limits.	b. Troubleshoot RCVV/CIVV position out of limits.

Table 1. N1C2 Out Of Limits, Intermediate (MIL) - Primary Mode (continued)

Step	Procedure	Result	Corrective Action
9.	Perform compressor bleed system functional check.	a. System functional check satisfactory.	a. Go to step 10.
		b. System functional check not satisfactory.	b. Inspect system. Replace parts as required.
10.	Perform EPR vs N1C2 check at Intermediate (MIL). Replace components in the following order until engine operates properly:	a. EPR vs N1C2 check within limits.	a. Return engine to service.
	• DEEC • MFC	b. EPR vs N1C2 check out of limits.	b. Replace next component and repeat step 10.

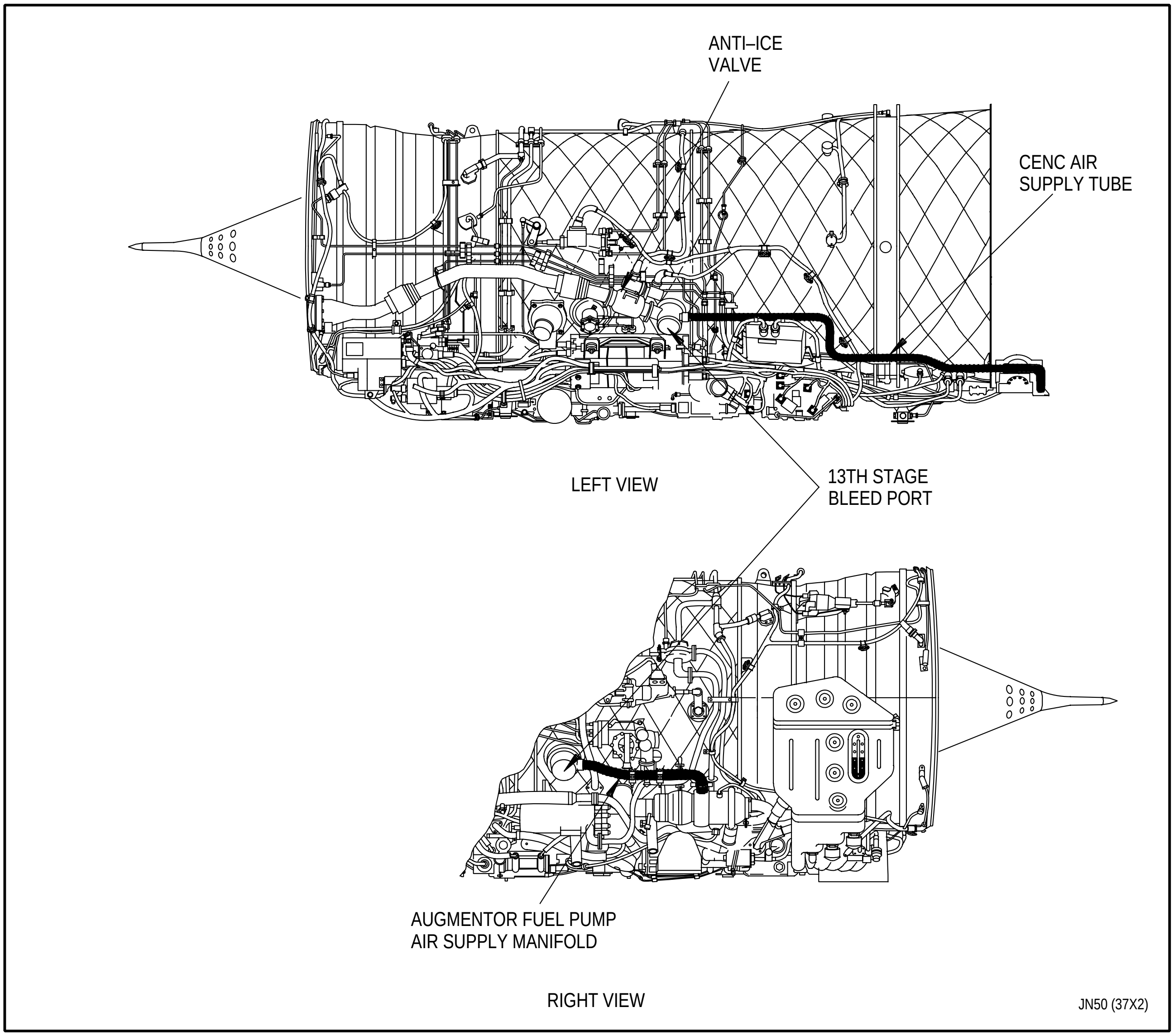


Figure 1. Engine Air Leak - Inspection

WORK PACKAGE

TECHNICAL PROCEDURES

MAXIMUM FUEL FLOW EXCEEDS LIMITS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
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REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Acceleration/Deceleration Checks	WP 213 00
Engine Troubleshooting - General	WP 501 00
System Fault Codes 4080 - 4084: N1 System	WP 608 00
System Fault Codes 4100 - 4102: Tt2 System	WP 610 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedures Using EAU	WP 652 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Augmentor Fuel System Analysis	WP 662 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Igniter - Spark, Gas Turbine Engine Augmentor	WP 025 00
Detector, Augmentor Light-Off	WP 041 00
Engine	T.O. 2J-F100-53-5
Flameholder Assembly, Augmentor Igniter - Inspection	WP 514 00
Augmentor Spray Manifold	TBD

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures when maximum fuel flow exceeds limits and no faults detected.

2. MAXIMUM FUEL FLOW EXCEEDS LIMITS.

(See Table 1.)

a. Description:

(1) During functional testing, maximum fuel flow/N1C2 (corrected to standard pressure) is compared to Tt2 to ensure maximum limit is not exceeded. Fuel flow higher than this limit will reduce augmentor liner life.

Table 1. Maximum Fuel Flow Exceeds Limits

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Check instrumentation: a. Compare test cell N1 and Tt2 instrumentation to DEEC values.	a.1. • N1 within ±50 RPM • Tt2 within ±9°F (±5°C)	a.1. Go to step 3.
		a.2. N1/Tt2 out of limits.	a.2.a. Check N1 and Tt2 instrumentation calibration. If test cell calibration within limits, go to a.2.b. and a.2.c. a.2.b. If N1 value out of limits, troubleshoot System Fault Code 4083. a.2.c. If Tt2 value out of limits, troubleshoot System Fault Code 4102.
	b. Compare Tt2A vs. Tt2B individual circuit inputs.	b.1. Individual Tt2 circuit values within ±5°F (±3°C).	b.1. Go to step 3.
		b.2. Individual circuit values out of limits.	b.2. If Tt2 value out of limits, troubleshoot System Fault Code 4102.

Table 1. Maximum Fuel Flow Exceeds Limits (continued)

Step	Procedure	Result	Corrective Action
3.	Visually inspect augmentor area for damage: • Flameholder • Flameholder Gap (especially between nose piece and inner and outer shrouds within 2 inches of igniters) • Sprayrings (especially Segment 1 pintles, shield, and brackets) • Igniters (burning/buckling) • LOD lens (contamination, broken)	a. No parts damaged. b. Parts damaged.	a. Go to step 4. b. Repair or replace parts as required.
4.	Check security of LOD mounting and electrical cable connector.	a. LOD secure. b. LOD loose.	a. Go to step 5. b. Repair LOD as required.
5.	Perform DEEC pressure sensing system analysis.	a. System passes analysis. b. System does not pass analysis.	a. Go to step 6. b. Replace system parts as required.
6.	Perform augmentor fuel system pressure analysis.	a. Fuel pressures within limits. b. Fuel pressures out of limits.	a. Replace components as required. b. Go to step 6.
7.	Perform accel/decel functional check and check augmentor operation. Replace components in the following order until engine operates properly: • AFC • Augmentor • sprayrings DEEC	a. Augmentor operates properly. b. Augmentor does not operate properly.	a. Return engine to service. b. Replace next component and repeat steps 5 and 6.

WORK PACKAGE

TECHNICAL PROCEDURES

ANTI-ICE SYSTEM MALFUNCTION

EFFECTIVITY: ENGINE MODEL F100-PW-229

This Work Package Supersedes WP 517 00 Through and Including Basic.

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
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REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
IDLE Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
EDU Test Procedures Using CEDS	WP 650 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
Compressive Engine Diagnostic System	T.O. 33D4-6-746-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Anti-ice System Malfunction	
	Volt/Ohmmeter	PSM-6 or equivalent
	Interface cables	PWA 56032 or PWA 56033
	ENGINE Analyzer Unit	PWA 56084
	CEDS Software	PWA 56091
	Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114

ILLUSTRATED SUPPORT EQUIPMENT

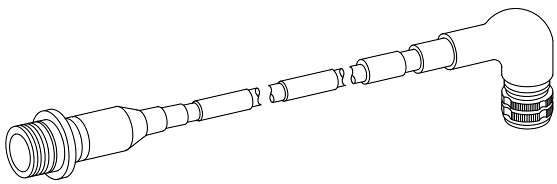


Figure T1. PWA 56032/PWA 56033 Interface Cable (Typical)

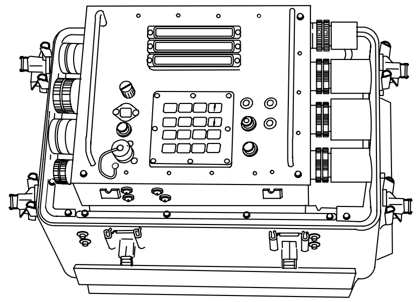


Figure T2. PWA 56084 Engine Analyzer Unit

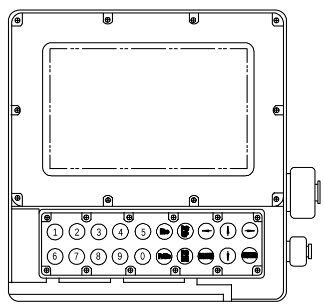


Figure T3. PWA 56102 Transfer Unit

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for anti-ice system malfunction.

2. ANTI-ICE SYSTEM MALFUNCTION. (See Table 1.)

a. Description:

(1) Anti-ice valve malfunctions are as follows:

(a) Ice formation on fan inlet guide vanes

(b) No response to anti-ice switch

(c) Hot anti-ice manifolds at all times indicating valve failed open, or ambient temperature manifolds at all times indicating valve failed closed.

(2) The anti-ice valve provides a supply of 13th stage compressor bleed air to the inlet fan case to prevent ice formation. An anti-ice valve failure, which causes valve to stick open, increases FTIT as much as 20°C (36°F). Loss of power to anti-ice valve will cause it to open. If the anti-ice valve solenoid will not open, fan inlet guide vanes may ice up and cause damage as ice falls off.

Table 1. Anti-ice System Malfunction

Step	Procedure	Result	Corrective Action
1.	Visually inspect anti-ice valve flange connections for axial gaps and/or gasket distress (gasket OD edges should be visible).	a. Gap or gasket distress apparent.	a. Repair as required. Check flange bolts and nuts for damage and ensure sufficient run-on torque for assembly.
		b. No gaps or gasket distress.	b. Go to step 2.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		

WARNING

Anti-ice manifold and tubing are hot. Do not touch these areas while checking for air leaks.

Step	Procedure	Result	Corrective Action
3.	Operate engine at IDLE. Perform following inspections:		
	a. Turn anti-ice switch ON andcheck anti-ice valve and manifold for leaks.	a.1. No leaks.	a.1. Go to step 4.
		a.2. Leaks.	a.2. Repair as required.

Table 1. Anti-ice System Malfunction (continued)

Step	Procedure	Result	Corrective Action
4.	Operate engine at IDLE for 2 minutes with anti-ice OFF. Observe anti-ice temperature (CEDS EDU TAICE or EAU word 1018). Turn anti-ice switch ON. Maintain IDLE for 1 minute. Turn anti-ice switch OFF.	a. Anti-ice temperature increases, then decreases a minimum of 20°C (36F) within 2 minutes after anti-ice switched OFF.	a. Go to step 5.
		b. Anti-ice temperature does not increase when valve switched ON.	b. Troubleshoot per System Fault Code 4252 (anti-ice system). Then, go to step 5.
		c. Anti-ice temperature increases but does not decrease a minimum of 20°C (36°F) within 2 minutes after anti-ice switched OFF.	c. Troubleshoot per System Fault Code 4251 (anti-ice system). Then, go to step 5.
5.	Turn anti-ice switch ON and stablize at IDLE for 1 minute. Increase PLA (CEDS EDU PLAAB or EAU word 1019) to 60 degrees PLA. Observe anti-ice temperature (CEDS EDU TAICE or EAU word 1018).	a. Anti-ice temperature does not decrease at least 20°C (36°F) within 2 minutes.	a. Troubleshoot per System Fault Code 4251 (anti-ice system).
		d.2. Anti-ice temperature decreases at least 20°C (36°F) within 2 minutes.	d.2. Return engine to service.

WORK PACKAGE

TECHNICAL PROCEDURES

IGNITION SYSTEM ANOMALIES

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 10

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REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Ignition System Analysis	WP 664 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Ignition System Anomaly	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for ignition system anomaly.

2. IGNITION SYSTEM ANOMALY.

(See Figures 1 through 3 and Table 1.)

a. Description:

(1) Ignition system anomalies are as follows:

(a) Engine no start

(b) Augmentor no-light

(2) The generator provides ignition voltage to exciters. Voltage is then stepped-up and delivered to the left and right igniters in pulses.

(3) Gas generator ignition is actuated mechanically by PLA input shaft on the MFC. Augmentor ignition is actuated by a relay in the AFC in response to a signal from the DEEC.

Table 1. Ignition System Anomaly

Step	Procedure	Result	Corrective Action
1.	Ensure generator and ignition electrical cable connectors are secure.	a. Connectors secure.	a. Go to step 2.
		b. Connectors not secure.	b.1. Disconnect connectors and check for arcing damage or contamination. b.2. If no damage or contamination present, connect connectors and go to step 2. b.3. If damage or contamination present, repair as required.
2.	Ensure test cell ignition switches are on.	a. All ignition status lights illuminated	a. Go to step 3.
		b. All ignition status lights illuminated	b. Press switch to obtain green status light.

NOTE

If gas generator ignition system is not suspect, go to step 5.

Step	Procedure	Result	Corrective Action
3.	Check gas generator ignition circuits. Perform following resistance checks. See figure 1.		
	a. CONN J119 PINS 1. C to D 2. C to GND 3. D to GND 4. G to H 5. G to GND 6. H to GND	a.1. Resistance checks within limits: 1. LT 10 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 10 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	a.1. Go to step 4.
		a.2. Resistance checks out of limits.	a.2. Replace generator stator.

Table 1. Ignition System Anomaly (continued)

Step	Procedure	Result	Corrective Action
4.	Check MFC ignition switch. Perform following resistance checks. See figure 1.		
	a. CONN J113 PINS	a. Resistance checks within limits:	Go to step 5.
	(PLA at CUTOFF)		
	1. A to B	1. LT 5 OHMS	
	2. A to GND	2. GT 100,000 OHMS	
	3. B to GND	3. GT 100,000 OHMS	
	4. D to E	4. LT 5 OHMS	
	5. D to GND	5. GT 100,000 OHMS	
	6. E to GND	6. GT 100,000 OHMS	
	(PLA at IDLE)		
	7. A to B	7. GT 100,000 OHMS	
	8. A to GND	8. GT 100,000 OHMS	
	9. B to GND	9. GT 100,000 OHMS	
	10. D to E	10. GT 100,000 OHMS	
	11. D to GND	11. GT 100,000 OHMS	
	12. E to GND	12. GT 100,000 OHMS	
		b. Resistance checks out of limits.	b. Replace MFC ignition switch module.

NOTE

If augmentor ignition system is not suspect, go to step 8.

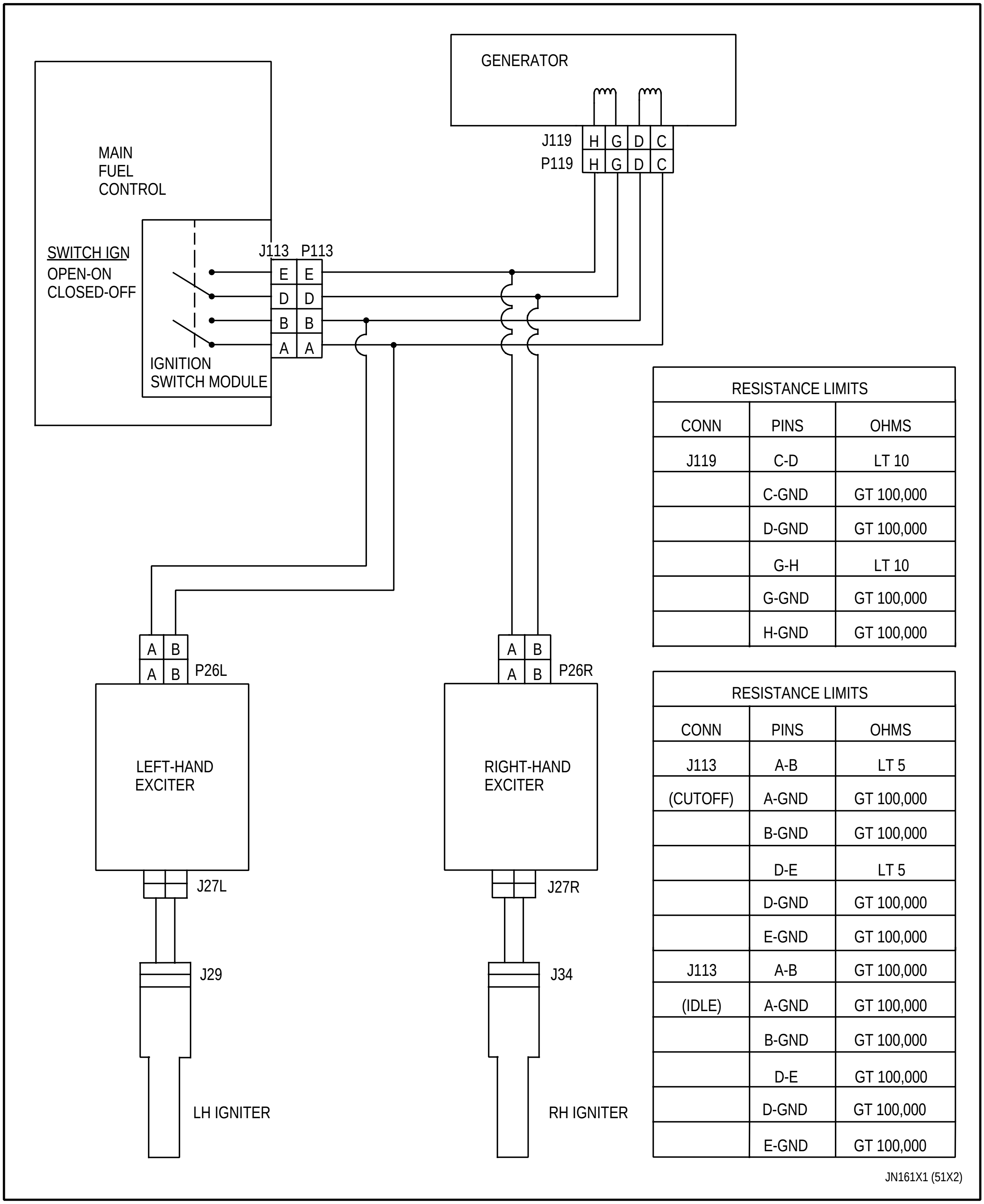
Step	Procedure	Result	Corrective Action
5.	Check augmentor ignition circuits. Perform following resistance checks. See figure 2.		
	a. CONN J119 PINS	a. Resistance checks within limits:	a. Go to step 6.
	1. E to F	1. LT 25 OHMS	
	2. E to GND	2. GT 100,000 OHMS	
	3. F to GND	3. GT 100,000 OHMS	
	4. J to K	4. LT 25 OHMS	
	5. J to GND	5. GT 100,000 OHMS	
	6. K to GND	6. GT 100,000 OHMS	
		b. Resistance checks out of limits.	b. Replace generator stator.

Table 1. Ignition System Anomaly (continued)

Step	Procedure	Result	Corrective Action
6.	Check AFC ignition relay circuit. Perform following resistance checks. See figure 3.		
	a. CONN P84 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	1. CC to AA 2. DD to AA 3. C to AA 4. d to AA	1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace AFC cable.
	b. CONN P84 PINS	b.1. Resistance checks within limits:	b.1. Go to step 7.
	1. CC to DD 2. CC to GND 3. DD to GND 4. d to C 5. d to GND 6. C to GND	1. 200 to 400 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Disconnect P97 from fill switch and ignition relay module. Go to c.
	c. CONN J97 PINS	c.1. Resistance checks within limits:	c.1. Replace augmentor control cable.
	1. A to B 2. A to GND 3. B to GND 4. C to D 5. C to GND 6. D to GND	1. 200 to 400 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Replace AFC ignition relay module.

Table 1. Ignition System Anomaly (continued)

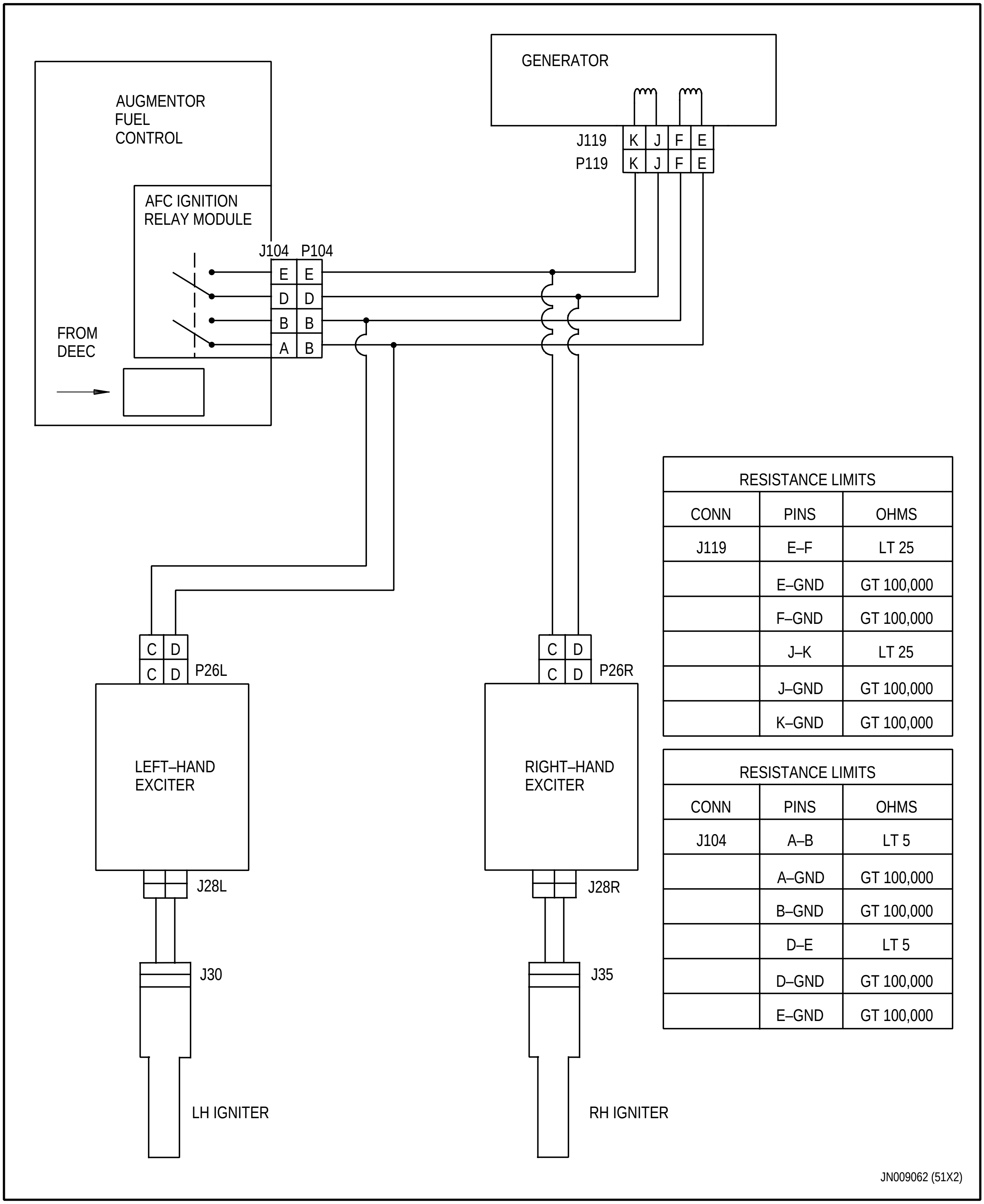
Step	Procedure	Result	Corrective Action
7.	Check AFC ignition switch circuits. Perform following resistance checks. See figure 2.		
	a. CONN J104 PINS 1. A to B 2. A to GND 3. B to GND 4. D to E 5. D to GND 6. E to GND	a. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	a. Go to step 8.
		b. Resistance checks out of limits.	b. Replace AFC ignition relay module.
8.	Perform ignition system analysis.	a. System passes analysis.	a. Return engine to service.
		b. System fails analysis.	b. Repair or replace components as required.



RESISTANCE LIMITS		
CONN	PINS	OHMS
J119	C-D	LT 10
	C-GND	GT 100,000
	D-GND	GT 100,000
	G-H	LT 10
	G-GND	GT 100,000
	H-GND	GT 100,000

RESISTANCE LIMITS		
CONN	PINS	OHMS
J113	A-B	LT 5
(CUTOFF)	A-GND	GT 100,000
	B-GND	GT 100,000
	D-E	LT 5
	D-GND	GT 100,000
	E-GND	GT 100,000
J113	A-B	GT 100,000
(IDLE)	A-GND	GT 100,000
	B-GND	GT 100,000
	D-E	GT 100,000
	D-GND	GT 100,000
	E-GND	GT 100,000

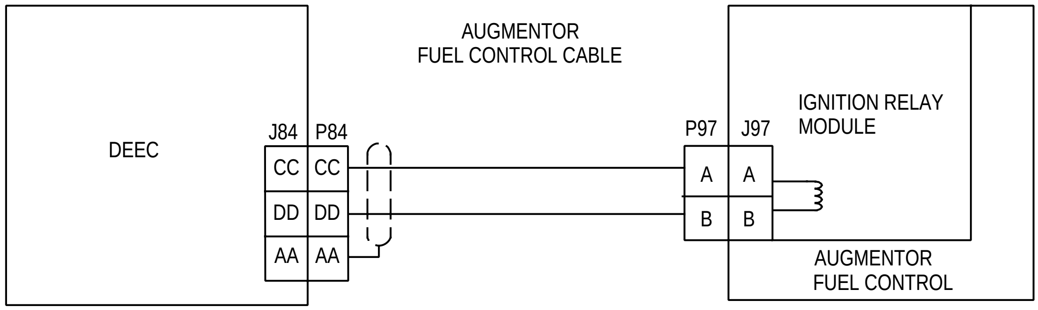
Figure 1. Gas Generator/MFC Ignition System Schematic Resistance Checks



RESISTANCE LIMITS		
CONN	PINS	OHMS
J119	E–F	LT 25
	E–GND	GT 100,000
	F–GND	GT 100,000
	J–K	LT 25
	J–GND	GT 100,000
	K–GND	GT 100,000

RESISTANCE LIMITS		
CONN	PINS	OHMS
J104	A–B	LT 5
	A–GND	GT 100,000
	B–GND	GT 100,000
	D–E	LT 5
	D–GND	GT 100,000
	E–GND	GT 100,000

Figure 2. Augmentor Ignition System Schematic - Generator Stator and AFC Ignition Switch Resistance Check



AFC IGNITION RELAY RESISTANCE LIMITS		
PINS P84	PINS J97	OHMS
CC–DD	A–B	200–400
CC–GND	A–GND	GT 100,000
DD–GND	B–GND	GT 100,000

JN009052 (24X2)

Figure 3. Augmentor Fuel Control Ignition Relay Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

DEEC PRESSURE TRANSDUCER MALFUNCTION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

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REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedures Using EAU	WP 652 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for DEEC pressure transducer malfunction.

2. DEEC PRESSURE TRANSDUCER MALFUNCTION.

(See Figures 1 through 3 and Table 1.)

a. Description:

(1) DEEC pressure transducer values do not closely match the same value measured by independent test cell transducers.

(2) The DEEC contains pressure transducers which measure Ps2 (nose cone), Pb (diffuser case), and Pt6 (EMSE probe). EMSE can display DEEC-measured Ps2, Pb, or Pt6 values for comparison to test cell measured values. A malfunction in either the test cell or DEEC transducers is present if the following limits are exceeded:

Parameter	Limit
Ps2	±0.1 in Hga
Pb	±5 psia
Pt6	±0.5 in Hga

(3) A DEEC pressure transducer malfunction can be induced by moisture or contamination in the sense line. Air leaks or blockage in the sense line will also cause out-of-limits operation. An internal failure in the DEEC board or transducer calibration circuitry can cause a malfunction and will generate a DEEC fault.

Table 1. DEEC Pressure Transducer Malfunction

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Inspect Ps2, Pb, and/or Pt6 sense line plumbing for leaks, loose fittings, blockage, or chafing. See figures 1, 2 and 3.	a. No leaks, loose fittings, blockage, or chafing in sense line.	a. Go to step 3.
		b. Plumbing requires repair.	b. Repair or replace plumbing as required.

NOTE

Engine must be shut down at least four hours or until FTIT is within 18°F (10°C) of Tamb before performing step 3.

Step	Procedure	Result	Corrective Action
3.	Check test cell Ps2, Pb, and Pt6 instrumentation calibration by comparing static (engine shutdown) values to Pamb.	a. Test cell instrumentation within ±0.1 in Hga (.05 psia) of Pamb pressure.	a. Go to step 4.
		b. Test cell instrumentation out of limits.	b. Recalibrate test cell instrumentation.

Table 1. DEEC Pressure Transducer Malfunction (continued)

Step	Procedure	Result	Corrective Action
4.	Check DEEC pressure transducers: Start engine and move throttle to Intermediate (MIL). Stabilize 3 minutes. Compare Pt2, Pb, and Pt6 values between EMSE and test cell instrumentation.	a. Values within limits:	a. Go to step 5.
	Pt2 (Word 42) Pb (Word 39) Pt6 (Word 40)	1. Pt2 within ±0.1 in Hga. 2. Pb within ±5.0 psia 3. Pt6 within ±0.5 in Hga	
		b. Pt2, Pb, or Pt6 value out of limits.	b.1. Check tubing between probe and DEEC for leakage. b.2. Remove DEEC for out-of-limits transducer change.
5.	Perform thrust parameter check.	a. Thrust parameters within limits.	a. Return engine to service.
		b. Thrust parameters out of limits.	b. Replace DEEC.

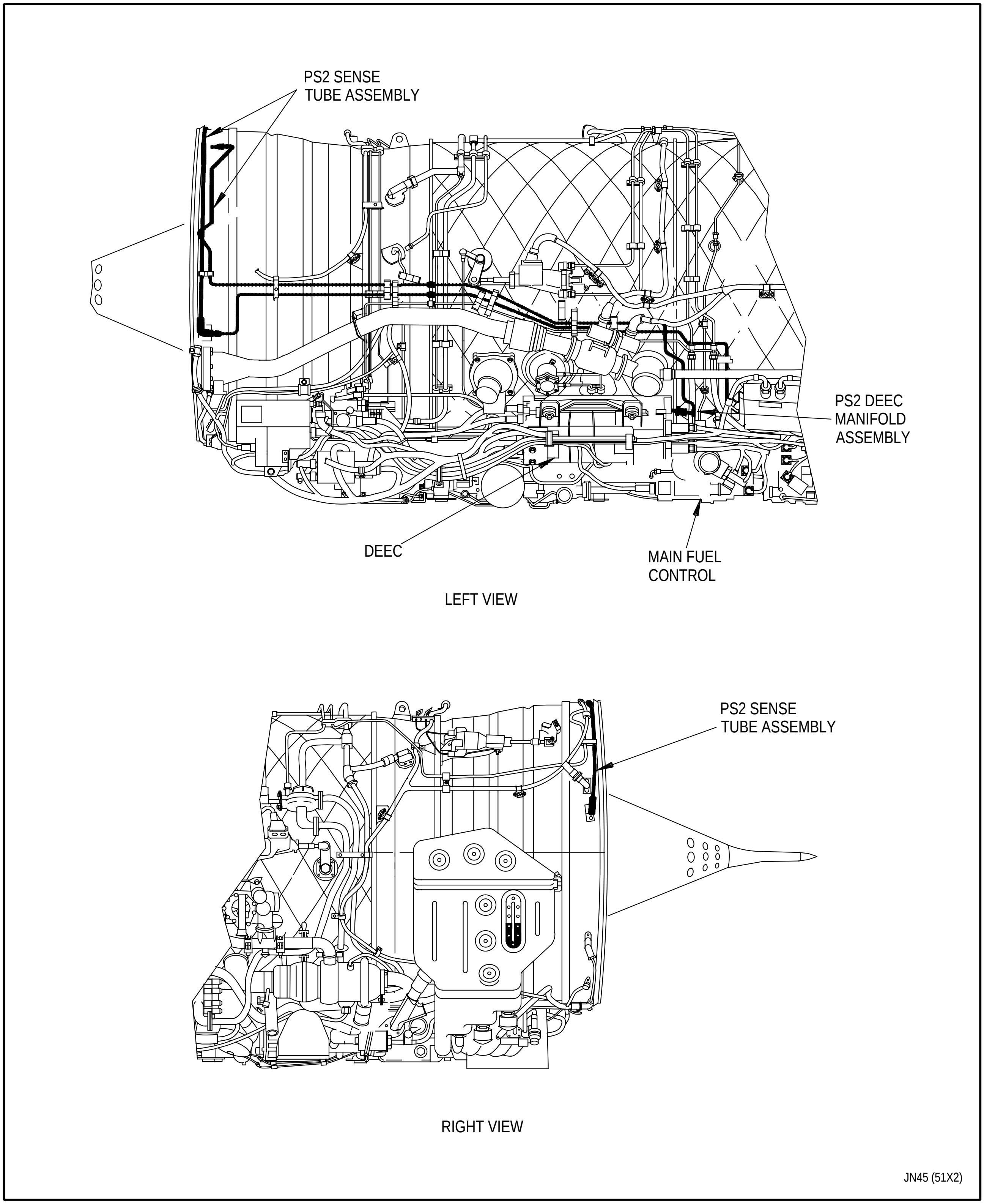


Figure 1. Ps2 Sense Line - Inspection

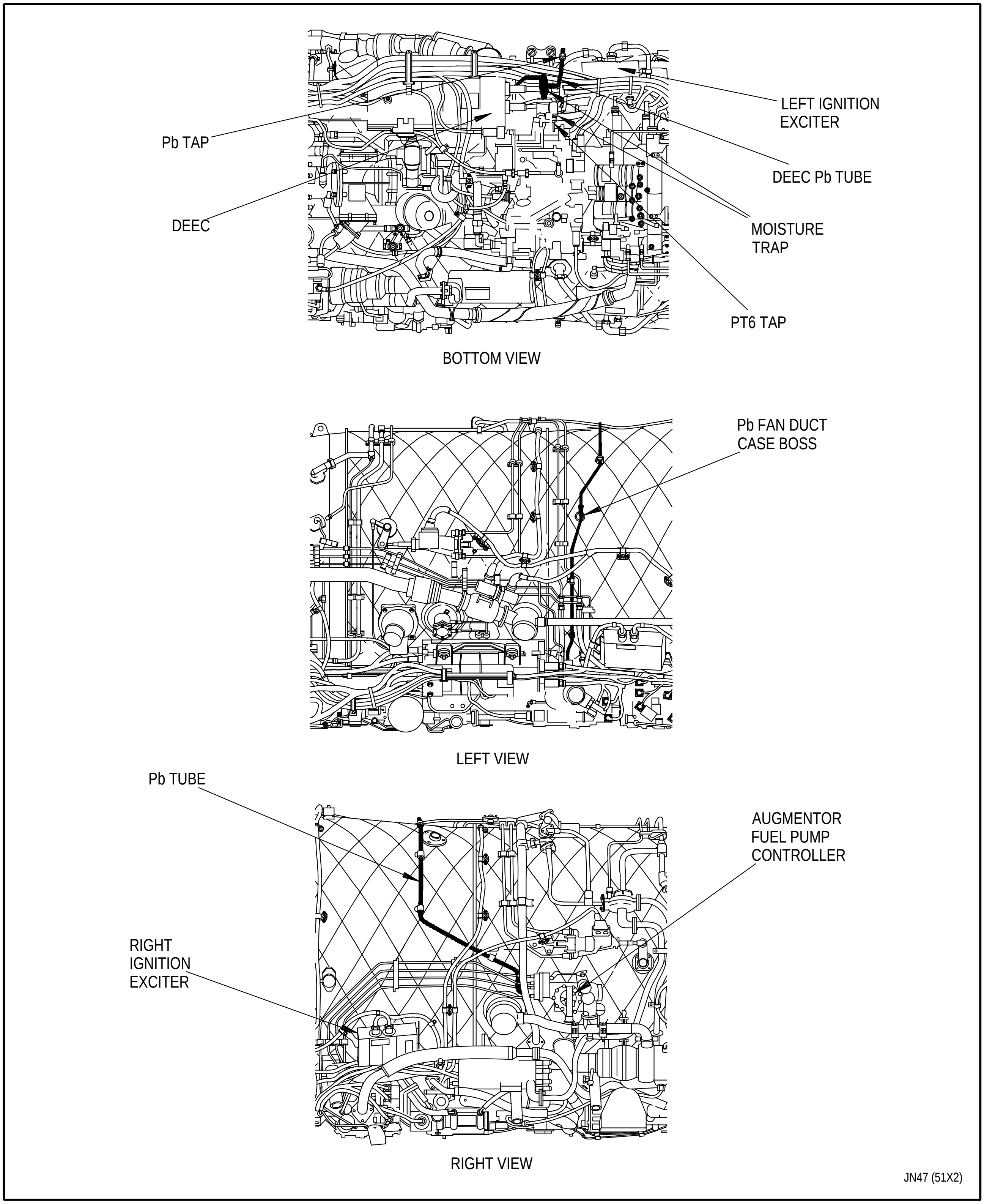


Figure 2. Pb Sense Line - Inspection

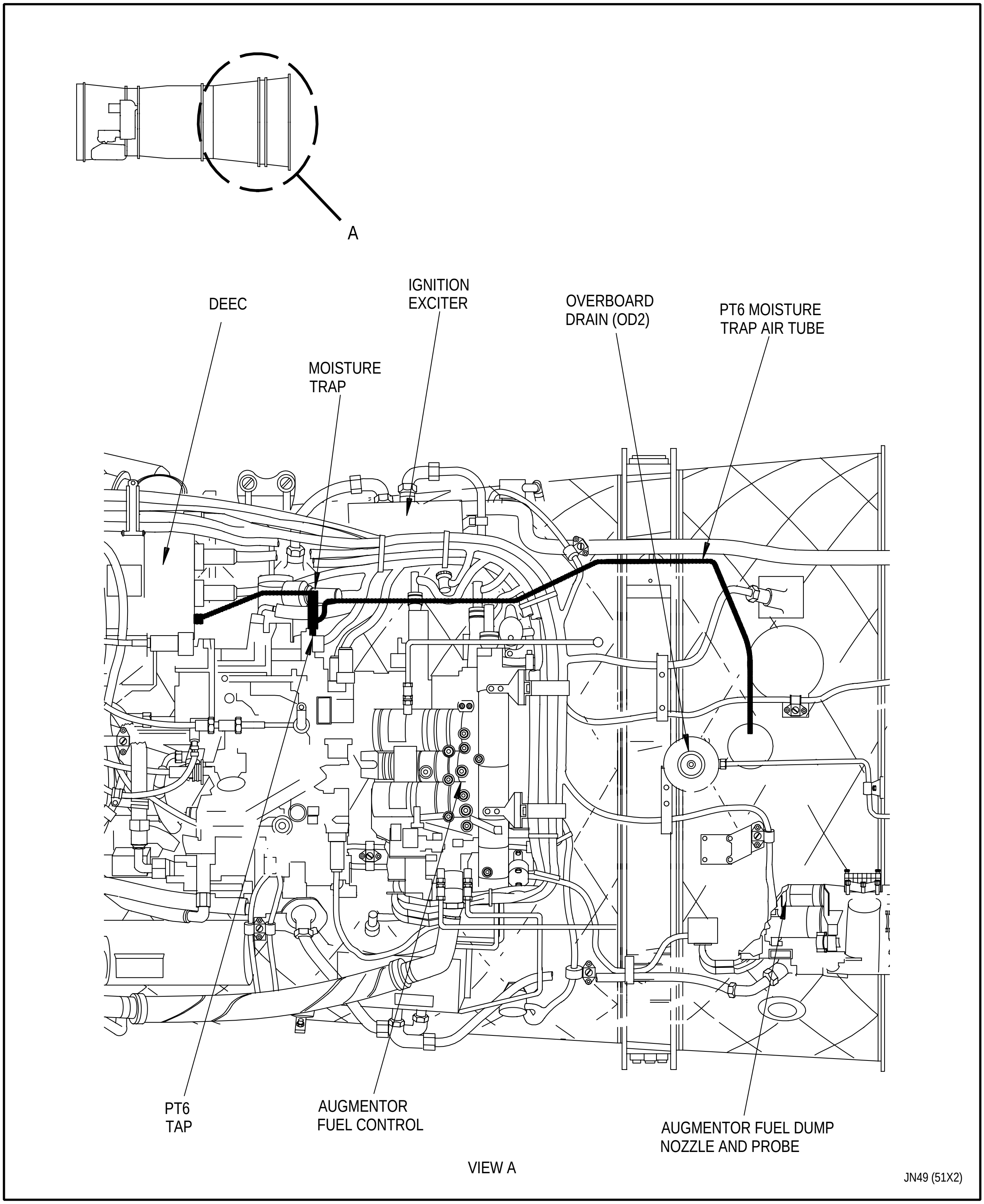


Figure 3. Pt6 - Sense Line - Inspection

WORK PACKAGE

TECHNICAL PROCEDURES

Mn SYSTEM MALFUNCTION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Acceptance Test	WP 212 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedures Using EAU	WP 652 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for Mn system malfunction.

2. Mn SYSTEM MALFUNCTION.

(See Table 1.)

a. Description:

(1) AUGMENTOR MN FAULT light illuminates if Mach number (Mn) input to DEEC is out of 144 to 3636 octal range.

(2) DEEC measures Mn in decimals. Normal count range corresponds to mach numbers between 0.15 and 2.80 (214 to 3564 octal).

(3) Values outside of normal range are held in range until input limits are reached.

(4) DEEC uses Mn=0.8 default value for scheduling:

(5) System Fault Code 4180 will occur if out-of-range condition exists and Idle Exhaust Nozzle switch is cycled (RESET-OFF-RESET).

(6) Mn Idle Lockout Non-Functional: Engine does not remain at Intermediate (MIL) when throttle is retarded to IDLE with Mn greater than 1072 octal.

b. Engine Symptoms:

(1) Engine N1C2 rpm high at IDLE (DEEC ID 1-020501 and subsequent)

(2) AUGMENTOR MN FAULT light illuminated with no faults or abnormal engine operation.

gbrKa

Table 1. Mn System Malfunction

Step	Procedure	Result	Corrective Action
1.	Check test cell Mn simulator POWER switch is ON. Check simulator Octal setting.	a. Simulated Mn display 0214 Octal.	a. Go to step 2.
		b. Simulated Mn display not 0214 Octal.	b. Set Octal to 0214. If problem still exists, go to step 2.
2.	Check Mn simulator: a. Set Mn (Octal) reading to 0214. Check Mn display on EMSE (word 79).	a.1. Mn 1.47 to 1.49.	a.1. Go to step 3.
		a.2. Mn out of limits.	a.2. Repair or replace Mn simulator and wiring.
	b. Set Mn (Octal) reading to 1071. Check Mn display on EMSE (word 79).	b.1. Mn 1.47 to 1.49.	b.1. Go to step 3.
		b.2. Mn out of limits.	b.2. Repair or replace Mn simulator and wiring.
3.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 4.
4.	Start engine and move throttle to Intermediate (MIL). Check PLA (word 24).	a. PLA 83 to 89°.	a. Go to step 5.
		b. PLA out of limits.	b. Rig test cell throttle cable.
5.	Perform Mn idle lockout check. Replace components in following order until engine operates properly: • Mn simulator • DEEC • Power and speed cable	a. Mn problem does not repeat.	a. Return engine to service
		b. Mn problem repeats.	b. Change the next component and repeat steps 4 and 5.

WORK PACKAGE

TECHNICAL PROCEDURES

FAULT RESET MALFUNCTION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

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REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedures Using EAU	WP 652 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Fault Reset Malfunction	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for fault reset malfunction.

2. FAULT RESET MALFUNCTION.

(See Figure 1 and Table 1.)

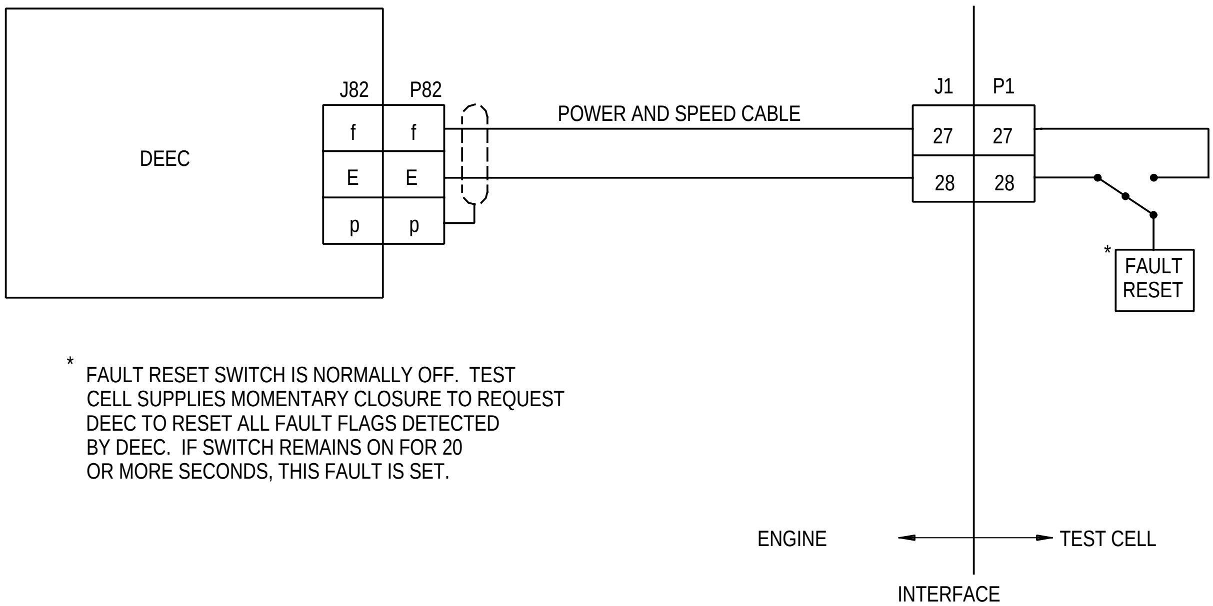
a. Description:

(1) AUGMENTOR MN FAULT light will not extinguish when FAULT RESET switch is pressed.

(2) FAULT RESET switch should clear AUGMENTOR MN faults. If fault is still present, fault light will remain illuminated after switch is released. The switch must remain pressed to stay on.

Table 1. Fault Reset Malfunction

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present. b. No events or faults present.	a. Troubleshoot individual event or fault codes. b. Go to step 2.
2.	Check fault reset signal from the test cell. Perform the following resistance checks. See figure 1. a. CONN PINS P82 FAULT RESET SWITCH - OFF 1. f to p 2. E to p b. CONN PINS P82 FAULT RESET SWITCH - ON 1. f to E FAULT RESET SWITCH - OFF 2. f to E 3. f to GND 4. E to GND c. CONN PINS P1 FAULT RESET SWITCH - ON 1. 27 to 28 FAULT RESET SWITCH - OFF 2. 27 to 28 3. 27 to GND 4. 28 to GND	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS a.2. Resistance checks out of limits. b.1. Resistance checks within limits: 1. LT 5 OHM 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS b.2. Resistance checks out of limits. c.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS c.2. Resistance checks out of limits.	a.1. Go to b. a.2. Replace power and speed cable. b.1. Go to step 3. b.2. Disconnect P1 from J1.Go to c. c.1. Replace power and speed cable. c.2. Repair test cell wiring as required.
3.	Perform IDLE functional check, and check engine operation.	a. Anomaly does not repeat. b. Anomaly repeats.	a. Return engine to service. b. Replace power and speed cable and repeat steps 2 and 3.



FAULT RESET SWITCH RESISTANCE LIMITS		
PINS P82	PINS P1	OHMS
f-E	27-28	LT5 (ON)
f-E	27-28	GT 100,000 (OFF)
f-GND	27-GND	GT 100,000 (OFF)
E-GND	28-GND	GT 100,000 (OFF)
f-p		GT 100,000 (OFF)
E-p		GT 100,000 (OFF)

JN37X1 (37X2)

Figure 1. Fault Reset Switch Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

MODE SELECT MALFUNCTION

EFFECTIVITY: ENGINE MODEL F100-PW-229

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Total Number of Pages in this WP is 10

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REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Secondary Mode Functional Check	WP 215 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedures Using EAU	WP 652 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Mode Select Malfunction	
	Volt/Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for mode select malfunction.

2. MODE SELECT MALFUNCTION.

(See Figure 1 and Table 1.)

a. Description:

(1) No Transfer To Secondary Mode: Engine remains in Primary Mode with mode select switch in SECONDARY mode.

(2) No Auto-Transfer To Secondary Mode: Engine remains in Primary Mode with engine faults which would normally cause an automatic transfer to SECONDARY mode.

(3) No Transfer To Primary Mode: Engine remains in Secondary Mode with PRIMARY mode selected.

Table 1. Mode Select Malfunction

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Check MFC mode solenoid (No. 1) switch. Perform following resistance checks. See figure 1.		
	a. CONN P82 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	1. FF to p	1. GT 100,000 OHMS	
	2. GG to p	2. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable.
	b. CONN P82 PINS	b.1. Resistance checks within limits:	b.1. Disconnect P2 from engine. Go to step 3.
	1. FF to GG	1. LT 5 OHMS	
	2. FF to GND	2. GT 100,000 OHMS	
	3. GG to GND	3. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Disconnect P112 from MFC. Go to c.
	c. CONN J112 PINS	c.1. Resistance checks within limits:	c.1. Replace power and speed cable.
	1. A to B	1. LT 5 OHMS	
	2. A to GND	2. GT 100,000 OHMS	
	3. B to GND	3. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Replace MFC.

Table 1. Mode Select Malfunction (continued)

Step	Procedure	Result	Corrective Action
3.	Check MFC mode solenoid (No. 2) switch. Perform following resistance checks. See figure 1. (Ensure P112 connected.)		
	a. CONN J2 PINS 1. 34 to 35 2. 34 to GND 3. 35 to GND	a.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	a.1. Go to step 4.
		a.2. Resistance checks out of limits.	a.2. Disconnect P121 from EDU. Go to b.
	b. CONN P121 PINS 1. C to D 2. C to GND 3. D to GND	b.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	b.1. Replace EDU.
		b.2. Resistance checks out of limits.	b.2. Disconnect P112 from MFC. Go to c.
	c. CONN J112 PINS 1. C to D 2. C to GND 3. to GND	c.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHM	c.1. Replace power and speed cable.
		c.2. Resistance checks out of limits.	c.2. Replace MFC.
4.	Check test cell power supply indicator. Perform following voltage checks: CONN P2 PINS 1. 34 to 35	a. Voltage check within limits: 1. 24 to 30 VDC	a. Connect P2 and go to step 5.
		b. Voltage check out of limits.	b. Repair test cell power supply to Secondary Mode solenoid.

Table 1. Mode Select Malfunction (continued)

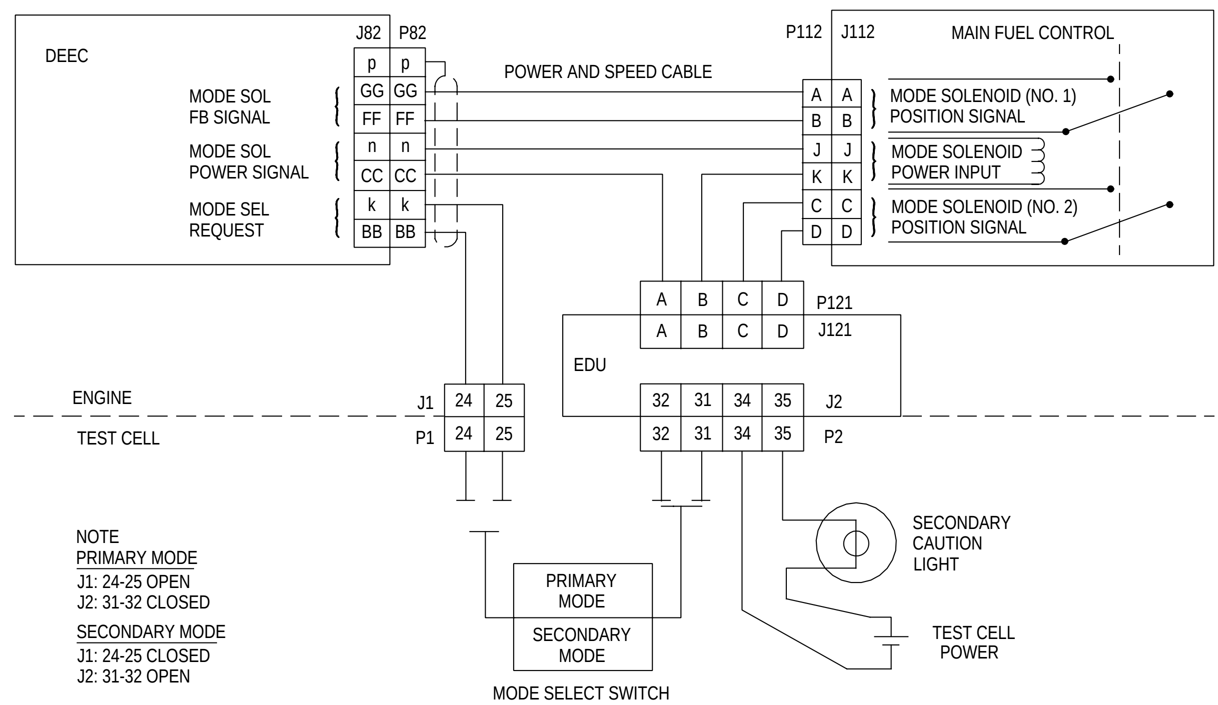
Step	Procedure	Result	Corrective Action
5.	Check mode solenoid power circuit. Move mode select switch to indicated position. Perform the following resistance checks. (Ensure P112 connected.)		
	a. CONN P82 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	PRIMARY mode		
	1. n to p	1. GT 100,000 OHMS	
	2. CC to p	2. GT 100,000 OHMS	
	3. k to p	3. GT 100,000 OHMS	
	4. BB to p	4. GT 100,000 OHMS	
	SECONDARY mode		
	5. n to p	5. GT 100,000 OHMS	
	6. CC to p	6. GT 100,000 OHMS	
	7. k to p	7. GT 100,000 OHMS	
	8. BB to p	8. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable.
	b. CONN P82 PINS	b.1. Resistance checks within limits:	b.1. Go to step 6
	PRIMARY mode		
	1. n to CC	1. 21 to 42 OHMS	
	2. n to GND	2. GT 100,000 OHMS	
	SECONDARY mode		
	3. n to CC	3. GT 100,000 OHMS	
	4. n to GND	4. GT 100,000 OHMS	
	5. CC to GND	5. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Disconnect P121 and go to c.
	c. CONN J121 PINS	c.1. Resistance checks within limits:	c.1. Disconnect P112 and go to e.
	PRIMARY mode		
	1. A to B	1. LT 5 OHMS	
	2. A to GND	2. GT 100,000 OHMS	
	3. B to GND	3. GT 100,000 OHMS	
	SECONDARY mode		
	4. A to B	4. GT 100,000 OHMS	
	5. A to GND	5. GT 100,000 OHMS	
	6. B to GND	6. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Disconnect P2 and go to d.

Table 1. Mode Select Malfunction (continued)

Step	Procedure	Result	Corrective Action
5. (cont'd)	d. CONN P2 PINS PRIMARY mode 1. 31 to 32 2. 31 to GND 3. 32 to GND SECONDARY mode 4. 31 to 32 5. 31 to GND 6. 32 to GND	d.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	d.1. Replace EDU.
		d.2. Resistance checks out of limits.	d.2. Repair or replace test cell wiring to mode select switches.
	e. CONN J112 PINS 1. J to K 2. J to GND 3. K to GND	e.1. Resistance checks within limits: 1. 21 to 42 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	e.1. Replace power and speed cable.
		e.2. Resistance checks out of limits.	e.2. Replace MFC mode solenoid switch assembly.
6.	Check mode select request circuit. Perform following resistance checks. (Ensure P112 connected.)		
	a. CONN P82 PINS PRIMARY mode 1. k to BB 2. k to GND 3. BB to GND SECONDARY mode 4. k to BB 5. k to GND 6. BB to GND	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	a.1. Go to step 7.
		a.2. Resistance checks out of limits.	a.2. Disconnect P1 and go to b.

Table 1. Mode Select Malfunction (continued)

Step	Procedure	Result	Corrective Action
6. (cont'd)	b. CONN P1 PINS PRIMARY mode 1. 24 to 25 2. 24 to GND 3. 25 to GND SECONDARY mode 4. 24 to 25 5. 24 to GND 6. 25 to GND	b.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Replace power and speed cable.
		b.2. Resistance checks out of limits.	b.2. Repair or replace test cell wiring connected to mode select switches.
7.	Perform secondary functional check and check engine operation. Replace components in following order until engine operates properly:	a. Engine transfers modes properly.	a. Return engine to service.
	• MFC mode solenoid module • MFC • DEEC • Power and speed cable	b. Engine does not transfer modes properly.	b. Replace next component and repeat step 7.



MODE SOLENOID SYSTEM RESISTANCE LIMITS

MODE	P82	J112	P121	J121	P2	J2	P1	LIMIT IN OHMS
	FF-GG FF-GND GG-GND	A-B A-GND B-GND						LT 5 GT 100,000 GT 100,000
	FF-p GG-p	C-D C-GND D-GND	C-D C-GND D-GND			34-35 34-GND 35-GND		LT 5 GT 100,000 GT 100,000
PRIMARY PRIMARY PRIMARY PRIMARY SECONDARY SECONDARY SECONDARY	n-CC n-GND n-CC n-GND CC-GND	J-K J-GND K-GND		A-B A-GND B-GND A-B A-GND B-GND	31-32 31-GND 32-GND 31-32 31-GND 32-GND			21-42 21-42 LT 5 GT 100,000 GT 100,000 GT 100,000 GT 100,000 GT 100,000 GT 100,000 GT 100,000
PRIMARY PRIMARY PRIMARY SECONDARY SECONDARY SECONDARY	k-BB k-GND BB-GND k-BB k-GND BB-GND						24-25 24-GND 25-GND 24-25 24-GND 25-GND	GT 100,000 GT 100,000 GT 100,000 LT 5 GT 100,000 GT 100,000
PRIMARY PRIMARY PRIMARY PRIMARY SECONDARY SECONDARY SECONDARY SECONDARY	n-p CC-p k-p BB-p n-p CC-p k-p BB-p							GT 100,000 GT 100,000 GT 100,000 GT 100,000 GT 100,000 GT 100,000 GT 100,000 GT 100,000

JN38X1 (51X2)

Figure 1. Mode Select Switch/Solenoid Circuit Schematic

WORK PACKAGE

TECHNICAL PROCEDURES

SECONDARY MODE ANOMALY

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	27	4 - 5	27	6 - 7	0
3	0			8 Blank	0

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Final Engine Dress (After Installation Into AF 8624151 Thrust Stand)	WP 102 00
Engine Acceptance Test	WP 212 00
Engine Fuel System Contamination	WP 305 00
Engine Troubleshooting - General	WP 501 00
Augmentor Anomalies	WP 512 00
Idle Speed Out of Limits	WP 514 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedures Using EAU	WP 652 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Control - Push-Pull Rear Compressor Variable Vane Feedback	WP 035 00
Cylinders - Actuating, Linear, Variable Vane, Rear Compressor - Rigging	WP 101 00
Control - Push-Pull Rear Compressor Variable Vane Feedback - Rigging	WP 102 00
Rear Compressor Variable Vane Internal Rigging Check	WP 104 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for SECONDARY MODE anomaly.

2. SECONDARY MODE ANOMALY.

(See Figures 1 and 2 and Table 1.)

a. Description:

(1) Stall: Engine stalls while in Secondary Mode.

(2) Flameout: Loss of combustion in gas generator section usually associated with reduction or loss of gas generator fuel flow in Secondary Mode. Simultaneously decreasing N1, N2 and FTIT indicate a flameout.

(3) Start Anomaly: Engine fails to start or hot starts during start attempt in Secondary Mode.

(4) Overspeed: N1 or N2 PM overspeed occurs with engine in Secondary Mode.

(5) Overtemperature: FTIT overtemperature occurs with engine in Secondary Mode.

Table 1. SECONDARY MODE Anomaly

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present. b. No events or faults present.	a. Troubleshoot individual event or fault codes. b. Go to step 2.
2.	Perform following visual engine inspections: a. Inspect fan inlet and turbine exhaust areas for damage or foreign objects. b. Perform engine rotation inspection. Core - Rotate PTO input shaft on gearbox with wrench. Check for binding or unusual noises. Fan - Rotate 1st fan blades by hand.	a.1. No damage or foreign objects. a.2. Damage or foreign objects. b.1. Core and fan rotate freely. b.2. Core does not rotate with PTO shaft. b.3. Binding or abnormal noises.	a.1. Go to b. a.2. Perform complete borescope inspection. b.1. Go to step 3. b.2. Remove gearbox module and troubleshoot lack of rotation. b.3. Tear down engine as required to repair.
3.	Check throttle linkage: a. Ensure MFC PLA linkage secure and rotates smoothly. b. Check throttle rigging.	a.1. PLA linkage serviceable. a.2. PLA linkage damaged. b.1. Throttle rigged properly. b.2. Throttle out of rig.	a.1. Go to b. a.2. Replace MFC. b.1. Go to step 4. b.2. Rig throttle as required.
4.	Inspect MFP filter ΔP indicator.	a. Filter indicator not extended. b. Filter indicator extended.	a. Go to step 5 b. Refer to fuel system contamination procedures.
5.	Check MFC Tt2 Sensor: a. Inspect fan inlet case probe for damage and proper installation b. Inspect armored capillary tube for excessive bending (kinks) and chafing. See figure 1.	a.1. Probe not damaged or installed improperly. a.2. Probe damaged or installed improperly. b.1. Tube not damaged. b.2. Tube damaged	a.1. Go to b. a.2. Repair or replace MFC Tt2 sensor as required. b.1. Go to step 6. b.2. Replace MFC Tt2 sensor assembly.
6.	Check MFC Ps2 sense line plumbing for leaks, loose fittings, chafing, or blockage. See figure 2.	a. No plumbing problems. b. Plumbing problems.	a. Go to step 7. b. Repair plumbing as required.

Table 1. SECONDARY MODE Anomaly (continued)

Step	Procedure	Result	Corrective Action
7.	Perform RCVV feedback cable rigging check.	a. Cable rigged properly.	a. Go to step 8.
		b. Cable out of rig.	b. Rig cable.
8.	Check RCVV internal rigging. Refer to T.O. 2J-F100-53-4, WP 104 00.	a. RCVV rigging correct.	a. Go to step 10,
		b. RCVV rigging not correct.	b. Go to step 9.
9.	Check RCVV external rigging. Refer to T.O. 2J-F100-53-4, WP 101 00.	a. RCVV rigging correct.	Rig internal RCVV system. Refer to T.O.2J-F100- 53-7, WP 702 00.
		b. RCVV rigging not correct	Rig external RCVV system. Refer to T.O.2J-F100- 53-4, WP 101 00.
10.	If stall, stall/stagnation, or flameout occurs during PRIMARY to SECONDARY mode transfer at IDLE, perform PRIMARY mode engine start and check IDLE N1 rpm.	a. IDLE N1C2 4200 to 4400 rpm.	a. Go to step 11.
		b. IDLE N1C2 greater than 4400 rpm.	b. Troubleshoot IDLE N1C2 rpm out of limits after going to step 11.
		c. IDLE N1C2 less than 4200 rpm.	c. Troubleshoot IDLE N1C1 rpm out of limits.
11.	Perform N2C2.5 rpm and RCVV Secondary Mode schedule checks.	a. N2C2.5 rpm and RCVV position within limits.	a. Go to step 10
		b. N2C2.5 rpm and RCVV position out of limits.	b. Troubleshoot N2C2.5 rpm or RCVV position out of limits per WP 539 00.
12.	Transfer to PRIMARY mode and duplicate throttle movement or obtain rpm where anomaly occurs.	a. Anomaly does not occur in PRIMARY mode.	a. • Replace MFC. • Replace core module.
		b. Anomaly occurs in PRIMARY mode.	b. Troubleshoot Primary Mode transfer anomaly.

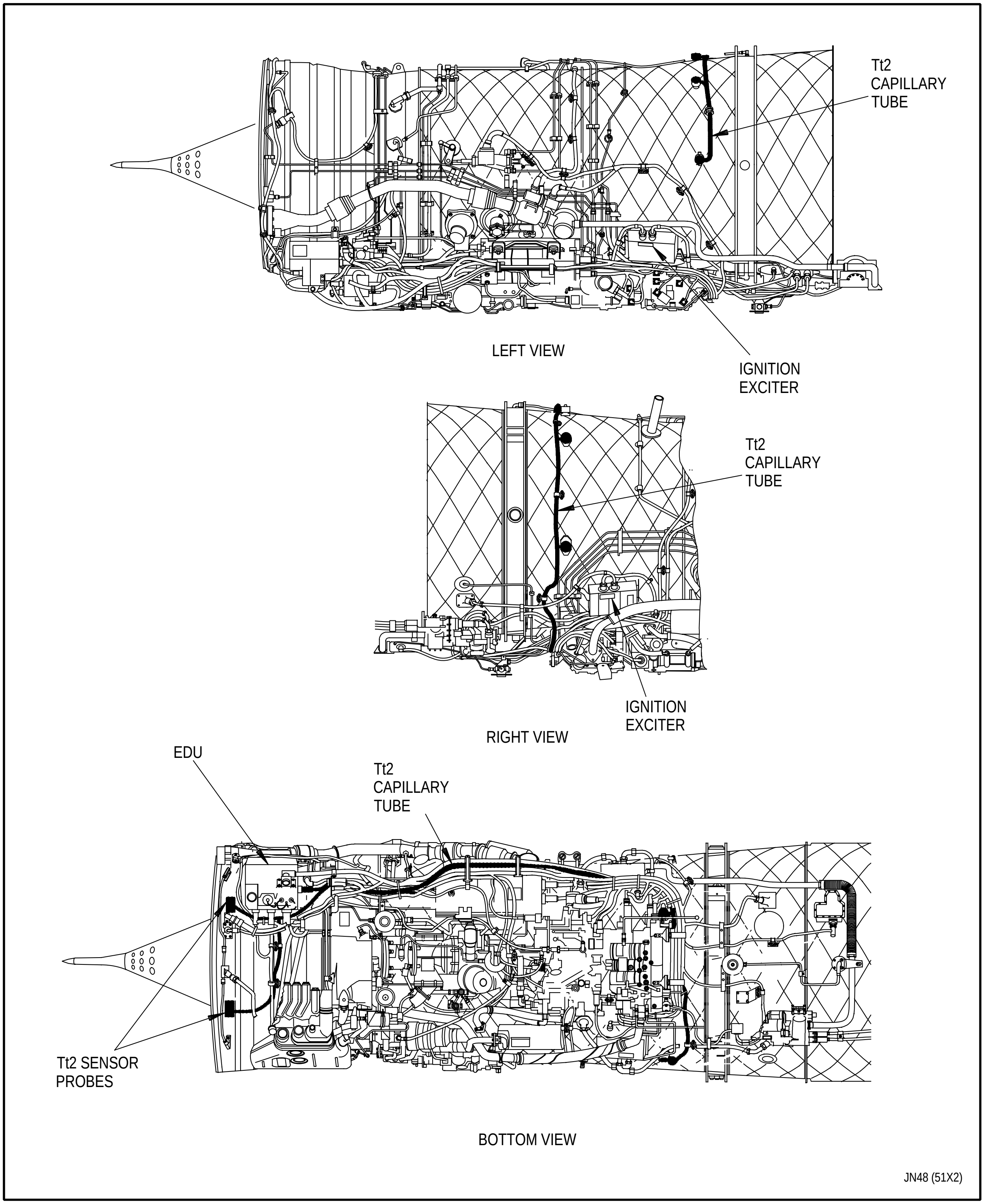


Figure 1. Main Fuel Control Tt2 Sensor Capillary Tube - Inspection

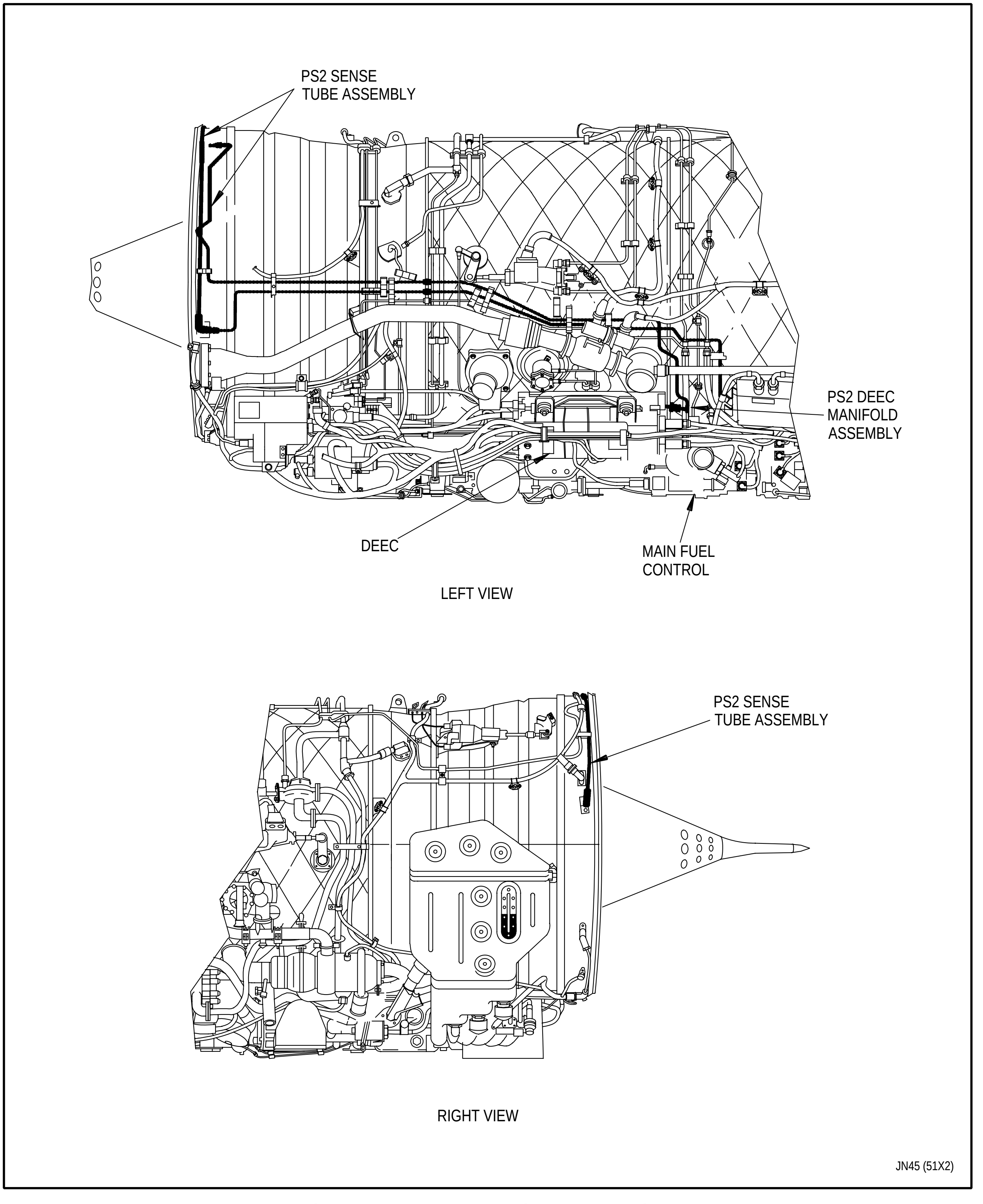


Figure 2. Ps2 Sense Line - Inspection

WORK PACKAGE

TECHNICAL PROCEDURES

EXHAUST NOZZLE POSITION OUT OF LIMITS - SECONDARY MODE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Start Procedures	WP 210 00
Engine Troubleshooting - General	WP 501 00
Exhaust Nozzle Position Out of Limits - Primary Mode	WP 513 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Secondary Mode Fuel System Analysis	WP 663 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Nozzle - Convergent, Actuation System, Integrity Check	WP 040 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for exhaust nozzle position out of limits - Secondary Mode with no faults indicated.

2. ENP OUT OF LIMITS - SECONDARY MODE. (See Table 1.)

a. Description:

(1) Exhaust Nozzle Position Out of Limits - Secondary Mode: ENP in Secondary Mode should be 5% or less at all power settings.

(2) Exhaust Nozzle Remains Closed After Transfer: ENP should open to Primary Mode ENP when engine transfers. At IDLE, Primary Mode ENP is 81 to 89%.

(3) Exhaust Nozzle Does Not Close After Transfer to Secondary Mode: ENP should immediately close to 5% or less when engine transfers to Secondary Mode.

(4) Exhaust Nozzle Schedules (Moves) With Engine in Secondary Mode: ENP should not move from the closed position (5% or less) during engine operation in Secondary Mode.

Table 1. ENP Out Of Limits - Secondary Mode

Step	Procedure	Result		Corrective Action	
1.	Review event and fault data.	a.	Events or faults present.	a.	Troubleshoot individual event or fault codes.
		b.	No events or faults present.	b.	Go to step 2.
2.	Perform IDLE functional check. Note ENP response.	a.	Exhaust nozzle operates properly and ENP within limits.	a.	Go to step 3.
		b.	ENP out-of-limits.	b.	Replace ENPT.
		c.	Exhaust nozzle does not operate properly.	c.	Troubleshoot ENP out of limits.
3.	Perform Secondary Mode fuel system analysis.	a.	DP (Pfmo-Pf1) within limits.	a.	Go to step 4.
		b.	DP (Pfmo-Pf1) out of limits.	b	Replace MFC.
4.	Perform exhaust nozzle integrity check.	a.	Exhaust nozzle operation normal.	a.	Replace CENC.
		b.	Exhaust nozzle operation abnormal.	b.	Replace exhaust nozzle hardware as required.

WORK PACKAGE

TECHNICAL PROCEDURES

RCVV POSITION OUT OF LIMITS - SECONDARY MODE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	0				
6 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Final Dress (After Installation Into AF 8624151 Thrust Stand)	WP 102 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Engine Accessories and Rigging Procedures	T.O.2J-F100-53-4
Control - Push-Pull, Rear Compressor Variable Vane Feedback - Rigging	WP 102 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for RCVV position out of limits in SECONDARY MODE.

2. RCVV POSITION OUT OF LIMITS - SECONDARY MODE.

(See Figure 1 and Table 1.)

a. Description:

(1) RCVV Angle vs. PLA in Secondary Mode out of limits; Cams in the MFC schedule RCVV position as a function of PLA (from throttle input shaft) and Tt2 (from MFC Tt2 sensor).

(2) RCVV position feedback is provided by a push-pull cable connected to the MFC and a synchronizing arm on the left RCVV actuator.

(3) Loss of helium in the Tt2 sensor capillary tube, improper throttle and feedback cable rigging, or RCVV actuation hardware binding can cause RCVV position to be out of limits.

Table 1. RCVV Position Out Of Limits - SECONDARY MODE

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present. b. No events or faults present.	a. Troubleshoot individual event or fault codes. b. Go to step 2.
2.	Check throttle linkage: a. Ensure MFC PLA linkage secure and rotates smoothly. b. Check throttle rigging.	a.1. Linkage serviceable. a.2. Linkage damaged. b.1. Throttle rigged properly. b.2. Throttle out of rig.	a.1. Go to b. a.2. Replace MFC. b.1. Go to step 3. b.2. Rig throttle as required.
3.	Check MFC Tt2 sensor: a. Inspect fan inlet case probe for damage and proper installation. b. Inspect armored capillary tube for excessive bending (kinks) and chafing. See figure 1.	a.1. Probe not damaged or installed improperly. a.2. Probe damaged or installed improperly. b.1. Tube not damaged. b.2. Tube damaged.	a.1. Go to b. a.2. Repair or replace MFC Tt2 sensor as required. b.1. Go to step 4. b.2. Replace MFC Tt2 sensor cable.
4.	Perform the following checks: a. RCVV feedback cable rigging check. b. Perform RCVV system actuation torque check.	a.1. Cable rigged properly. a.2. Cable rigging out of limits. b.1. RCVV linkage movement normal. b.2. RCVV linkage binds or requires excessive force to actuate.	a.1. Go to b. a.2. Rig cable. b.1. Replace MFC. b.2. Replace RCVV feedback cable or MFC as required.

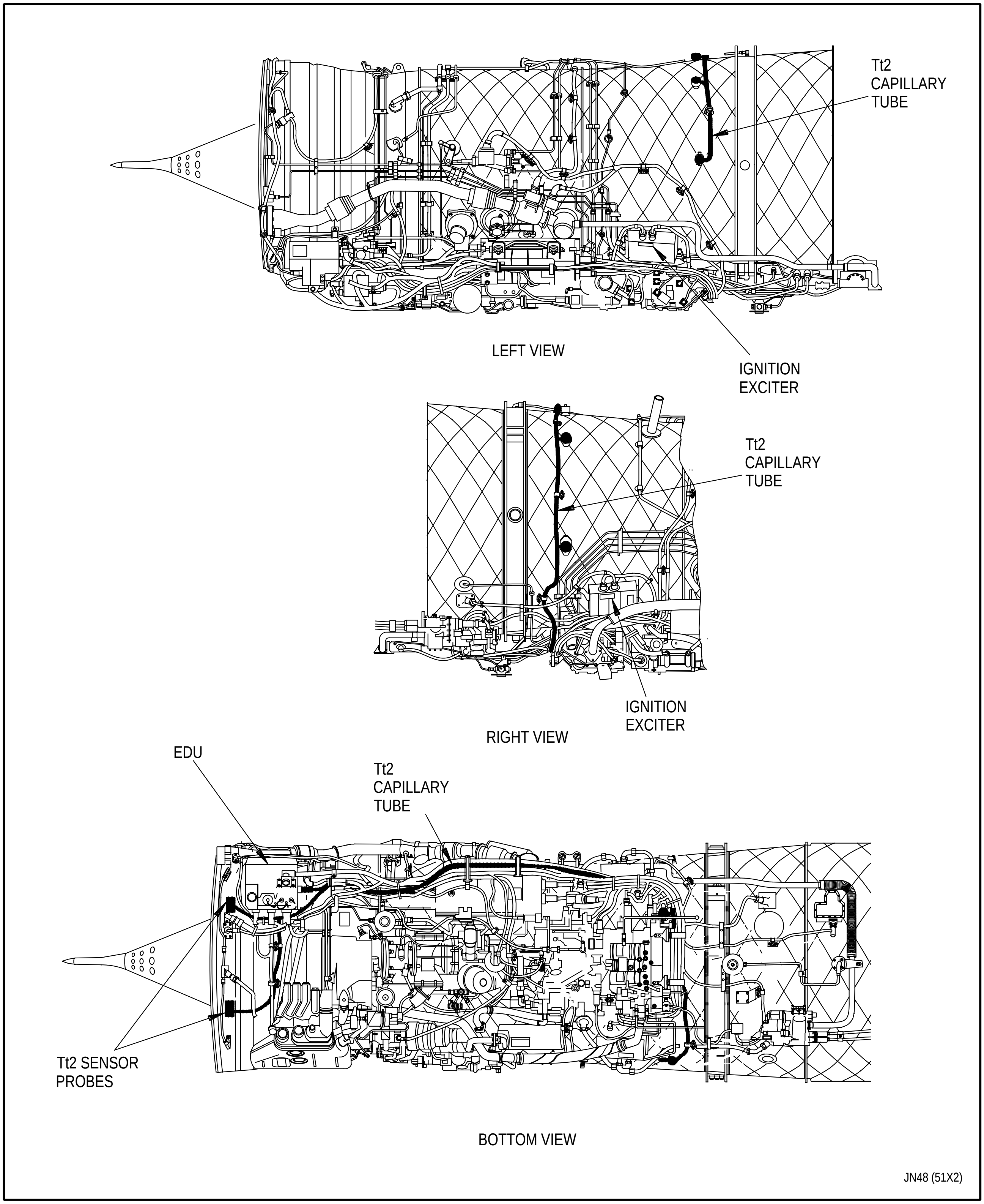


Figure 1. Main Fuel Control Tt2 Sensor Capillary Tube - Inspection

WORK PACKAGE

TECHNICAL PROCEDURES

CIVV MALFUNCTION - SECONDARY MODE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 3	0				
4 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Secondary Mode Fuel System Analysis	WP 663 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Control and Cylinder - Variable Vane, Compressor Inlet	WP 036 00
Cylinder - Actuating, Linear, Variable Vane,Compressor Inlet	WP 037 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for CIVV malfunction, SECONDARY mode.

2. CIVV MALFUNCTION - SECONDARY MODE.

(See Table 1.)

a. Description:

(1) CIVV should move to retracted (cambered) position when engine is in Secondary Mode. Pfmo fuel pressure, supplied by MFC, retracts CIVV actuators when engine is in Secondary Mode.

Table 1. CIVV Malfunction - SECONDARY MODE

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present. b. No events or faults present.	a. Troubleshoot individual event or fault codes. b. Go to step 2.
2.	Inspect CIVV system for smooth operation and freedom from binding.	a. CIVV system operates normally. b. CIVV system does not operate normally.	a. Go to step 3. b. Repair or replace CIVV actuation parts as required.
3.	Perform Secondary Mode fuel system analysis.	a. DP (Pfmo-Pf1) within limits. b. DP (Pfmo-Pf1) out of limits.	a. Replace CIVV control cylinder. b. Replace MFC.

WORK PACKAGE

TECHNICAL PROCEDURES

MAIN FUEL PUMP FILTER ΔP INDICATOR EXTENDED

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 3	0	4 Blank	0		

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Pretest and Posttest Procedures ---------------	T.O. 2J-F100-11-2
Engine Fuel System Contamination -----------------	WP 305 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for main fuel pump (MFP) filter ΔP indicator extended.

2. MFP FILTER ΔP INDICATOR EXTENDED.

(See Table 1.)

a. Description:

(1) The MFP filter ΔP indicator will extend when pressure across the filter exceeds approximately 30 psid.

(2) Fuel system contamination is usually responsible for excessive pressure across filter.

Table 1. MFP Filter ΔP Indicator Extended

Step	Procedure	Result	Corrective Action
1.	See fuel system contamination procedures.	a. No contamination present. b. Contamination present.	a. Return engine to service. b. Return engine as required.

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE INLET - FUEL LEAKAGE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	18				

REFERENCE MATERIAL REQUIRED

Title	Number
Depot Engine Accessories and Rigging Procedures ------	T.O. 2J-F100-53-4
Control - Fuel, Main --------------------------	WP 009 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for fuel leakage from engine inlet.

2. ENGINE INLET - FUEL LEAKAGE.

(See Figure 1 and Table 1.)

a. Description:

(1) Fuel is present in engine inlet from SEC Ps2 sense ports per figure 1, indicating a malfunctioning main fuel control (MFC).

Table 1. Engine Inlet - Fuel Leakage

Step	Procedure	Result	Corrective Action
1.	Verify source of fuel in engine inlet.	a. Leakage from SEC Ps2 ports in fan inlet case.	a. Replace main fuel control. Refer to T.O. 2J-F100-53-4, WP 009 00. Return engine to service.

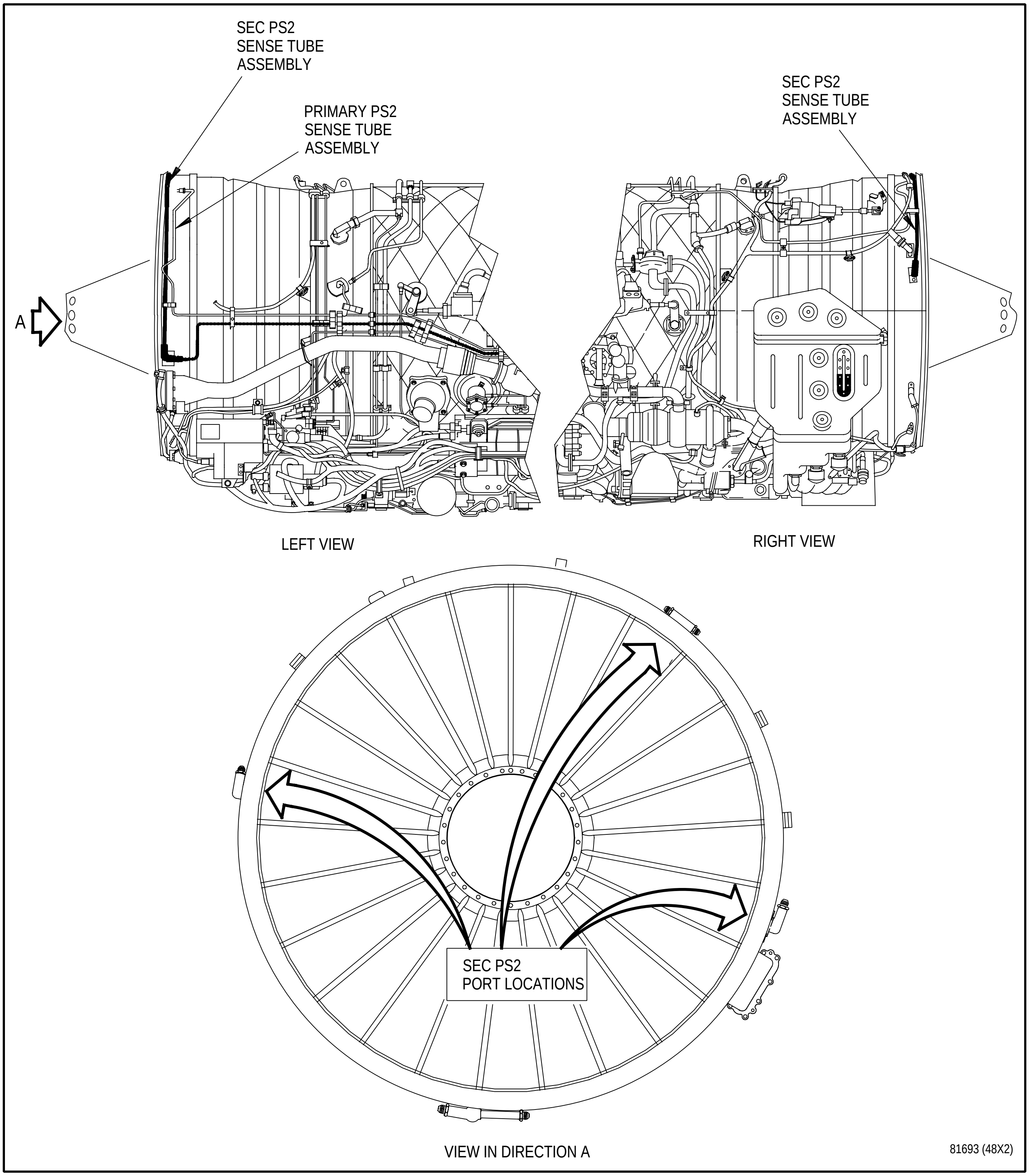


Figure 1. SEC Ps2 Sense Line and Port Locations

WORK PACKAGE

TECHNICAL PROCEDURES

LOW OR FLUCTUATING OIL PRESSURE OUT OF LIMITS AND BREATHER PRESSURE SYSTEM ANOMALIES

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	27	2	0	3 - 6	27

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Oil System Servicing	WP 109 00
Engine Posttest Servicing	WP 301 00
Oil System Contamination	WP 304 00
Engine Troubleshooting - General	WP 501 00
Engine	T.O. 2J-F100-53-5
Main Gearbox No. 2 and 3 Bearing Compartment and No. 4 Bearing Compartment - Inspection	WP 429 00
Nozzle, No. 1 Bearing Oil - Airflow Check Bearing Compartment, No. 1 - Leak Check Inspection	WP 430 00
Compartment, No. 5 Bearing Vacuum Leak Check	WP 439 00
Oil Nozzles No. 2 and 3 Bearing - Airflow Check	WP 703 00
Compartment, No. 4 Bearing - Vacuum Check	WP 709 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for low or fluctuating oil pressure out of limits and breather pressure system anomalies.

2. LOW OR FLUCTUATING OIL PRESSURE OUT OF LIMITS AND BREATHER PRESSURE SYSTEM ANOMALIES.

(See Table 1.)

a. Description.

(1) Low main oil pressure (MOP) is less than 20 psid at IDLE or 35 psid at Intermediate (MIL).

(2) Fluctuating MOP varies more than ±5 psid at IDLE or ±10 psid at Intermediate (MIL).

(3) Oil breather pressure (Pmb) is more than 4.0 in. Hg at power setting.

Table 1. Low Or Fluctuating Oil Pressure Out Of Limits And Breather Pressure System Anomalies

Step	Procedure	Result	Corrective Action
1.	Check oil filter ΔP indicator.	a. Indicator not extended.	a. Go to step 2.
		b. Indicator extended.	b.1. Remove filter element for inspection.
			b.2. If element contaminated or damaged, replace and perform oil system contamination procedures.
2.	Operate engine at IDLE:		
	a. Compare MOPT oil value to POPD value.	a.1. MOP vs POPD within limits.	a.1. Go to b.
		a.2. MOP vs POPD out of limits.	a.2. Replace MOPT.
	b. Check Pmb pressure.	b.1. Pmb within limits.	b.1. Go to step 3.
		b.2. Pmb out of limits.	b.2.a. Replace breather pressurizing valve.
			b.2.b. Vacuum check No. 2 and 3 bearing compartment and gearbox. Reject gearbox if out of limits.
3.	Remove and inspect chip detectors.	a. Chip detectors not contaminated.	a. Go to step 4.
		b. Chip detectors contaminated.	b. Perform oil system contamination procedures.
4.	Operate engine above IDLE. Shut down and check oil tank sight gage immediately. Perform following inspections:		
	a. Check sight gage oil level.	a.1. Oil tank level within limits (green area).	a.1. Go to b.
		a.2. Oil tank level out of limits (red area).	a.2. Service oil system.

Table 1. Low Or Fluctuating Oil Pressure Out Of Limits And Breather Pressure System Anomalies (continued)

Step	Procedure	Result	Corrective Action
4. (cont'd)	b. Check sight gage for foam in oil.	b.1. No foam.	b.1. Go to step 5.
		b.2. Foam.	b.2. Perform following steps: a. Drain gearbox and oil tank. b. Service oil system. c. Operate engine at 11,200 rpm for 10 minutes. d. Shut down engine and check for foam in oil tank sight gage. e. If problem exists after five cycles, troubleshoot oil system contamination.
5.	Operate engine at Intermediate (MIL). Check following parameters:		
	a. MOT	a.1. MOT within limits. a.2. MOT out of limits.	a.1. Go to b. a.2. Go to step 8.
	b. No. 1, 4, and 5 bearing scavenge pressure: 1. PSCAV-1 2. PSCAV-4 3. PSCAV-5	b.1. Scavenge pressures within limits. 1. PSCAV-1 less than 25 psia. 2. PSCAV-4 less than 63 psia. 3. PSCAV-5 less than 30 psia.	b.1. Go to step 6.
		b.2. Scavenge pressure out of limits.	b.2. Vacuum check bearing compartment with out-of-limit scavenge pressure.

Table 1. Low Or Fluctuating Oil Pressure Out Of Limits And Breather Pressure System Anomalies (continued)

Step	Procedure	Result	Corrective Action
6.	If not previously accomplished, vacuum check No. 1, 4, and 5 bearing compartments and gearbox.	a. Vacuum checks within limits.	a. Go to step 7.
		b. Vacuum checks out of limits.	b.1. Tear down engine as required to inspect bearing compartment out of limits. b.2. If gearbox out of limits, replace gearbox module.
7.	If MOP is low at IDLE, airflow check No. 2-3 bearing compartment oil jets.	a. Oil jet airflow within limits.	a. Go to step 8.
		b. Oil jet airflow out of limits.	b. Tear down engine to inspect No. 2-3 bearing compartment.
8.	Check oil pressure and replace components in the following order until oil pressure is within limits. • Fuel/Oil coolers (MOT out of limits only) • Main oil pump • Gearbox module	a. MOP within limits.	a. Return engine to service.
		b. MOP out of limits.	b. Replace next component and repeat steps 7 and 8.

WORK PACKAGE

TECHNICAL PROCEDURES

MAIN OIL PRESSURE HIGH OUT OF LIMITS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	12	3	12	4 Blank	12
2	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Acceleration/Deceleration Checks	WP 213 00
Oil System Contamination	WP 304 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Engine	T.O. 2J-F100-53-5
Nozzle, No. 1 Bearing Oil - Airflow Check and Bearing Compartment, No. 1 - Leak Check Inspection	WP 430 00
Compartment, No. 5 Bearing - Vacuum Check	WP 439 00
Core Engine Module	T.O. 2J-F100-53-7
Oil Nozzles, No. 4 Bearing - Airflow check	WP 620 00
Oil Nozzles, No. 2 and 3 Bearing - Airflow Check	WP 708 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures when main oil pressure (MOP) is high out of limits.

2. MOP HIGH OUT OF LIMITS.

(See Table 1.)

a. Description:

(1) MOP greater than 95 psid or exceeds 100 psid during start

Table 1. MOP High Out Of Limits

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Inspect oil filter element for damage.	a. Element not damaged.	a. Replace element.
		b. Element damaged.	b. Inspect oil system.
3.	Operate engine at IDLE. Compare MOPT signal value to Popd value.	a. MOP vs. Popd within limits.	a. Go to step 4.
		b. MOP vs. Popd out of limits	b. Replace MOPT.
4.	Inspect oil strainers for contamination.	a. Strainers contaminated.	a. Go to step 5.
		b. Strainers not contaminated.	b. Inspect oil system.
5.	Airflow check all bearing compartment oil jets.	a. Airflows within limits.	a. Go to step 6.
		b. Airflows out of limits.	b. Tear down engine to inspect out-of-limits bearing compartment.
6.	Perform accel/decel functional check and check engine MOP. Replace components in following order until engine operates properly:	a. MOP within limits.	a. Return engine to service.
	••• Main oil pump BPV Gearbox module	b. MOP out of limits.	b.Replace next component and repeat step 6.

WORK PACKAGE

TECHNICAL PROCEDURES

MAIN OIL PRESSURE RISE BETWEEN IDLE AND INTERMEDIATE (MIL) OUT OF LIMITS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Test	WP 002 00
Engine Oil System Servicing	WP 109 00
Engine Posttest Servicing	WP 301 00
Oil System Contamination	WP 304 00
Engine Troubleshooting - General	WP 501 00
EPR vs N1C2 Out of Limits, Intermediate (MIL) Power - Primary Mode	WP 515 00
Low or Fluctuating Oil Pressure Out of Limits	WP 529 00
Downloading and Reviewing Data Using CEDS	WP 651 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for main oil pressure (MOP) rise between IDLE and Intermediate (MIL) out of limits.

2. MOP RISE BETWEEN IDLE AND INTERMEDIATE (MIL) OUT OF LIMITS.

(See Table 1.)

a. Description:

(1) MOP rises at least 15 psid between IDLE and Intermediate (MIL). Intermediate (MIL) MOP value should be checked between 5 and 20 seconds after engine has reached Intermediate (MIL).

Table 1. MOP Rise Between IDLE And Intermediate (MIL) Out Of Limits

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Operate engine above IDLE. Shut down and check oil tank sight gage immediately. Perform following inspections:		
	a. Check sight gage oil level.	a.1. Oil level within limits, (green area).	a.1. Go to b.
		a.2. Oil level out of limits, (red area).	a.2. Service oil system.
	b. Check sight gage for foam.	b.1. No foam.	b.1. Go to step 3.
		b.2. Foam.	b.2. Perform following: a. Drain gearbox and oil tank. b. Service oil system. c. Operate engine at 11,200 rpm for 10 minutes. d. Shut down engine and check for foam in tank sight glass. e. If problem exists after five cycles, troubleshoot oil system contamination.
3.	Perform thrust parameter check.	a. Thrust parameter within limits.	a. Troubleshoot low oil pressure.
		b. Thrust parameter out of limits.	b. Troubleshoot thrust parameter out of limits.

WORK PACKAGE

TECHNICAL PROCEDURES

OIL SMOKE EMITTING FROM EXHAUST NOZZLE, FAN INLET OIL PUDDLING, HIGH OIL CONSUMPTION, INTERNAL OIL LEAKAGE, OR SUSPECT OVERSERVICING/OIL HIDING

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 3	24				
4	5				
5 - 6 Added	5				
7 - 8 Added	24				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Oil System Servicing	WP 109 00
Engine Oil Consumption Check Run	WP 545 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Detector - Metal Chip, Oil Sump	WP 033 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00
Main Gearbox No. 2 and No. 3 Bearing Compartment and No. 4 Bearing Compartment - Inspection	WP 429 00
Nozzle, No. 1 Bearing Oil; Bearing Compartment, No. 1 - Airflow and Vacuum Leak Check	WP 430 00
Nozzle, No. 5 Bearing Oil - Airflow Check	WP 431 00
Compartment, No. 5 Bearing - Vacuum Check	WP 439 00
Core Engine Module	T.O. 2J-F100-53-7
Compartment, No. 4 Bearing - Vacuum Check	WP 708 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for oil smoke emitting from exhaust nozzle, fan inlet oil puddling, high oil consumption, internal oil leakage, or suspect overservicing/oil hiding.

2. OIL SMOKE EMITTING FROM EXHAUST NOZZLE, HIGH OIL CONSUMPTION OR INTERNAL OIL LEAKAGE.

(See Table 1.)

a. Description:

(1) Oil Smoke: Occasional puffs of smoke from engine exhaust during acceleration and deceleration are normal, provided no other oil system malfunction (such as low oil pressure, high oil consumption, etc.) occurs. Engine should be shut down and troubleshot if smoke continues.

(2) High Oil Consumption: Excessive oil consumption indicates internal or external oil leakage. Leakage can be verified during daily oil level inspections or during oil consumption run.

(3) Internal Oil Leakage: Oil weting, coking or puddling originating from oil supply tube, scavenge tube or bearing compartment.

3. FAN INLET OIL PUDDLING.

(See Table 2.)

a. Description:

(1) Occasional inlet oil puddling may occur for one of the following reasons:

(a) Overservicing of oil system. This may be indicated by oil level above 48 half-pint graduation level within 30 minutes of shutdown.

(b) Oil collecting in fan rotor between 2nd and 3rd disks. Oil may leak to inlet if oil drain hole stops at bottom-dead-center (approximately 1/2 ounce or less).

(c) Prolonged engine run at IDLE rpm or below IDLE rpm induces lower pressure outside No. 2/3 bearing compartment, particularly at rear of No. 3 compartment. This condition causes oil to leak from compartment.

(d) Oil puddling due to defective or incorrectly installed seals in No. 1 or 2/3 bearing compartments.

Table 1. Oil Smoke Emitting From Exhaust Nozzle, High Oil Consumption Or Internal Oil Leakage.

Step	Procedure	Result	Corrective Action
1.	Inspect engine for external oil leaks.	a. No leaks. b. Leaks.	a. Go to step 2. b. Repair leaks and perform oil consumption run. If still out of limits, go to step 2.
2.	Borescope inspect entire engine for internal oil leakage.	a. No internal leakage. b. Internal leakage.	a. Go to step 3. b. Repair leakage and perform oil consumption run. If still out of limits, go to step 3.
3.	If not previously accomplished, perform an oil consumption run per WP 545 00.	a. Oil consumption within limits. b. Oil consumption out of limits.	a. Go to step 4. b. Tear down engine to determine source of oil leaks.
4.	Vacuum check all bearing compartments.	a. Vacuum checks within limits. b. Vacuum checks out of limits.	a. Go to step 5. b. Tear down engine to inspect out-of-limits bearing compartment.
5.	Perform 10 psi airflow check of all bearing compartments.	a. Airflow checks within limits. b. Airflow checks out of limits.	a. Return engine to service. b. Tear down engine to inspect out-of-limits bearing compartment.

Table 2. FAN INLET OIL PUDDLING

Step	Procedure	Result	Corrective Action
	NOTE • An oil consumption run should be accomplished. If doubt concerning oil level readings or servicing documentation exists. • Oil level shall be checked within 30 minutes of shutdown.		
	Is oil consumption in excess of limits? (documentation check)	a. Yes.	a. Go to step 6.
		b. No.	b. Go to step 2.
2.	Is oil level above 48 half-pints?(Check within 30 minutes of shutdown)	a. Yes (above 48 half-pints but still in area B).	a.1. Drain oil to overflow level (approximately 48 half-pints).
			a.2. Clean oil puddle from fan inlet case, fan inlet struts, and flaps. Return engine to service.
		b. Yes (in area A on sight gage).	b. Drain oil to overflow level and troubleshoot for fuel in oil. **NOTE** If engine experiences frequent inlet oil puddling, engine may be rejected and oil seals inspected.
		c. No (below 48 half-pints but still in area B).	c. Clean oil puddle if required and return engine to service.
		d. No (below 48 half-pints and below area B).	d.1. Service oil tank.
			d.2. Go to step 6.

Table 2. Fan Inlet Oil Puddling (continued)

Step	Procedure	Result	Corrective Action
3.	Perform oil consumption run. Is consumption within limits?	a. Yes.	a. Clean oil puddle and return engine to service.
		b. No.	b. Go to step 4.
4.	Inspect lower inlet struts and flaps for oil wetness. Any wetness found?	a. Yes.	a.1. If leakage is determined to come from quad N1 sensor area, remove sensor and discard sensor packing. Install new packing and sensor. If problem persists, reject engine and return to shop.
			a.2. If leakage is determined not coming from quad N1 sensor, reject engine for No. 1 bearing area leak.
		b. No.	b. Go to step 5.
5.	Inspect bottom of fan case for visible oil. Any evidence of oil?	a. Yes.	a. Reject engine for No. 2/3 bearing leak.
		b. No.	b. Reject engine and return to shop.
6.	Check engine IDLE rpm. Is rpm within limits?	a. Yes.	a. Go to step 3.
		b. No.	b. Troubleshoot IDLE rpm out of limits.

4. SUSPECT OVERSERVICE/OIL HIDING.
(See Table 3.)

a. Description:

(1) Engine overservicing with oil hiding within engine bearing compartments and gearbox can be evidenced by a variable oil level after each shutdown, oil leakage from gearbox breather horn, oil leakage after engine shutdown from No. 5 bearing compartment (observed by oil wetness on turbine exhaust case strut and No. 5 scavenge tube at 6 o’clock position only), or smoke out the exhaust or fan after engine shutdown.

This may occur for one of the following reasons:

(a) Addition of too much oil during oil servicing procedure.

(b) Oil migration from oil tank to gearbox due to:

- Internal oil tank tubing leakage.
- Over limits oil pump clearances.

Table 3. Suspect Overservice or Oil Hiding

Step	Procedure	Result	Corrective Action
	NOTE Draining oil from oil tank is not required.		
1.	Drain oil from gearbox by removing gearbox chip detector. Reinstall chip detector. Refer to T.O. 2J-F100-53-4, WP 033 00.		
2.	Service oil system per Initial Service procedures per WP 109 00. Record final oil tank level at 5 minutes after shutdown.		
3.	Run engine for 5 minutes. Record tank level at 5 and 30 minutes after shutdown.		

Table 3. Suspect Overservice or Oil Hiding (continued)

Step	Procedure	Result	Corrective Action
4.	Compare oil tank levels recorded in step 3 with final oil level recorded in step 2.	a. Level varies more than 3 graduations between runs in steps 2 and 3, or drops more than 3 graduations over 30 minutes after run in step 3.	a. Inspect, repair, or replace the following items, one at a time, and repeat steps 1 through 4, until problem is resolved: • RCVV actuator rigging. • Oil tank. • Oil pump. • Return engine to shop for gearbox removal and inspection for restricted oil flow from No. 2/3 bearing compartment to gearbox.
		b. Level varies less than 3 graduations between runs in steps 2 and 3, and drops less than 3 graduations over 30 minutes after run in step 3.	b. Return engine to service.

WORK PACKAGE

TECHNICAL PROCEDURES

OVERBOARD FUEL/OIL DRAINAGE OUT OF LIMITS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 10

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Troubleshooting	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Oil Smoke Emitting From Exhaust Nozzle or High Oil Consumption	WP 532 00
Engine Oil Consumption Check Run	WP 545 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00
Gearbox Module	T.O. 2J-F100-53-11
Gearshaft Assembly, Bevel, Spur, Gearbox Drive - Inspection	WP 314 00
Deaerator Impeller Shaft - Inspection	WP 317 00
Oil Seal Retainer Assembly, Gearbox - Inspection	WP 330 00
Augmentor Spray Manifold	TBD

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for overboard fuel/oil drainage out of limits.

2. OVERBOARD FUEL/OIL DRAINAGE OUT OF LIMITS.

(See Figure 1 and Tables 1 and 2.)

a. Description:

(1) The following components have drain tubes connected to one of three drains:

(a) Gearbox Drain

- Breather Pressurizing Valve (BPV)
- PTO Output Drive Pad and Alternator Drive Pad

(b) Front Drain (OD1)

- P&D Valve
- Augmentor Fuel Pump (AFP) and Fuel/Oil Cooler
- Reduction Gearbox (Main Fuel Pump Drive Pad)
- Compressor Bleed Cylinder

(c) Rear Drain (OD2)

- Augmentor Duct
- DEEC Transducer Moisture Traps
- CENC

Table 1. Overboard Fuel/Oil Drainage Out of Limits

Step	Procedure	Result	Corrective Action
1.	Ensure gang drainage is not from leaks onto drain.	a. Leakage from gang drains.	a. Go to step 2.
		b. Leakage from another source.	b. Repair as required.
2.	Determine which drain is leaking. See figure 1.	a. Gearbox drain leaking.	a. Go to step 3.
		b. Front drain (OD1) leaking.	b. Go to step 6.
		c. Rear drain (OD2) leaking.	c. Go to step 7.
3.	Determine if oil system is serviced properly.	a. Oil system serviced properly.	a. Go to step 4.
		b. Oil system not serviced properly.	b. Perform Suspect Overservicing/ Oil Hiding troubleshooting per WP 532 00. Recheck leakage.
4.	a. Remove breather pressurizing valve. Inspect BPV carbon seal and mating face on gearbox deaerator shaft for any anomalies.	a.1. No anomalies.	a.1. Reinstall BPV.
		a.2. Anomalies.	a.2. Replace parts as required. Go to b.
	b. Disconnect gearbox drain tube from BPV. Run engine at IDLE 5 minutes. Monitor leakage from gearbox drain tube and BPV during engine run. Perform engine shutdown and continue monitoring for 10 minutes following engine shutdown. Compare leakage rate to table 2.	b.1. Out-of-limits leakage from BPV drain.	b.1. Replace components in following order and repeat b. • Main oil pump • Oil tank

Table 1. Overboard Fuel/Oil Drainage Out of Limits (continued)

Step	Procedure	Result	Corrective Action
4. continued		b.2. Out-of-limits leakage from gearbox drain tube.	b.2. Inspect PTO and alternator drive pad outer carbon seals. Repair as required.
			b.3. If problem still exists, replace gearbox module.
		c. No out-of-limits leaks.	c. Return engine to service.
5.	Disconnect tubes from front drain (OD1). Run engine at IDLE 5 minutes and check each tube for leakage. Compare leakage rate to table 2.	a. Leakage from P&D valve drain tube out of limits.	a. Replace P&D valve.
		b. Leakage from AFP/ fuel-oil cooler drain tube out of limits.	b.1. Disconnect tube from drain port of AFP. Check leakage at IDLE.
			b.2. If leakage out of limits, replace AFP.
			b.3. If leakage within limits, replace fuel/oil cooler.
		c. Leakage from reduction gearbox drain tube out of limits.	c.1. If fuel leaking, replace MFP.
			c.2. If oil leaking, replace gearbox module.
		d. Leakage from compressor bleed cylinder drain tube out of limits.	d. Replace compressor bleed cylinder.
		e. No leaks.	e. Return engine to service.

Table 1. Overboard Fuel/Oil Drainage Out of Limits (continued)

Step	Procedure	Result	Corrective Action
6.	Disconnect tubes from rear drain (OD2). Run engine at IDLE and check each tube for leakage.	a. Leakage from CENC drain tube out of limits.	a. Replace CENC.
		b. Leakage from DEEC moisture trap drain tube.	b.1. Disconnect tubes from Pt6 and Pb moisture traps. Check leakage from each trap.
			b.2. If leakage from Pb line, replace AFPC. Also borescope hot section (AP 4 and AP 6). Go to step c.
			b.3. If leakage from Pt6, replace augmentor fuel dump nozzle and probe assembly. Go to step d.
		c. Remove Pb line from DEEC and inspect transducer port for fluid contamination.	c.1. No fluid present in Pb transducer. Reconnect Pb line and return to service.
			c.2. Fluid is present in Pb transducer. Replace DEEC for Pb transducer replacement.

Table 1A. Overboard Fuel/Oil Drainage Out of Limits (continued)

Step	Procedure	Result	Corrective Action
6. con-tinued		d. Remove Pt6 line from DEEC and inspect transducer port for fluid contamination.	d.1. No fluid present in Pt6 transducer. Reconnect Pt6 line and return to service. d.2. Fluid is present in Pt6 transducer. Replace DEEC for Pt6 transducer replacement.
		e. Leakage from combustion chamber fuel drain tube out of limits.	e.1. Shut down engine. Inspect augmentor duct for leakage. e.2. If oil leaking, troubleshoot high oil consumption. e.3. If fuel leaking, inspect augmentor sprayrings. Replace or repair as necessary.
		f. No leaks.	f. Return engine to service.

Table 2. Overboard Fuel and Oil Drain Limits - At Steady State Running Conditions

Main Overboard Drain - Location	Main Overboard Drain - Limit	Remarks	Individual Unit Drain	Fluid	Individual Unit Drain - Limit*
Gearbox	1.5 cc/min	If gearbox overboard drain out of limits, troubleshoot.	PTO drive pad	Oil	15 drops/min
			Breather overboard outlet	Oil	15 drops/min
Front (OD1)	4.3 cc/min	If front overboard drain out of limits, troubleshoot.	P&D valve	Fuel	15 drops/min
			AFP	Fuel	20 drops/min
			Compressor bleed cylinder	Fuel	0 drops/min
			Fuel/oil cooler	Fuel and oil	5 drops/min
			Gearbox speed reducer drive pad	Oil and fuel	45 drops/min
Rear (OD2)	1.5 cc/min	If rear overboard drain out of limits, troubleshoot.	CENC	Fuel	30 drops/min
			Augmentor duct	Fuel and oil	0 drops/min**
			DEEC transducer moisture traps	Fuel	0 drops/ min***

* Twenty drops equal approximately one cubic centimeter (cc) of fuel or lubricating oil.

** Inspect augmentor exhaust duct. If no leakage source found, motor engine to blow fuel or oil out. Otherwise, troubleshoot fuel or oil leakage.

*** If fuel leaking from Pb line, borescope hot section (AP4 and AP6).

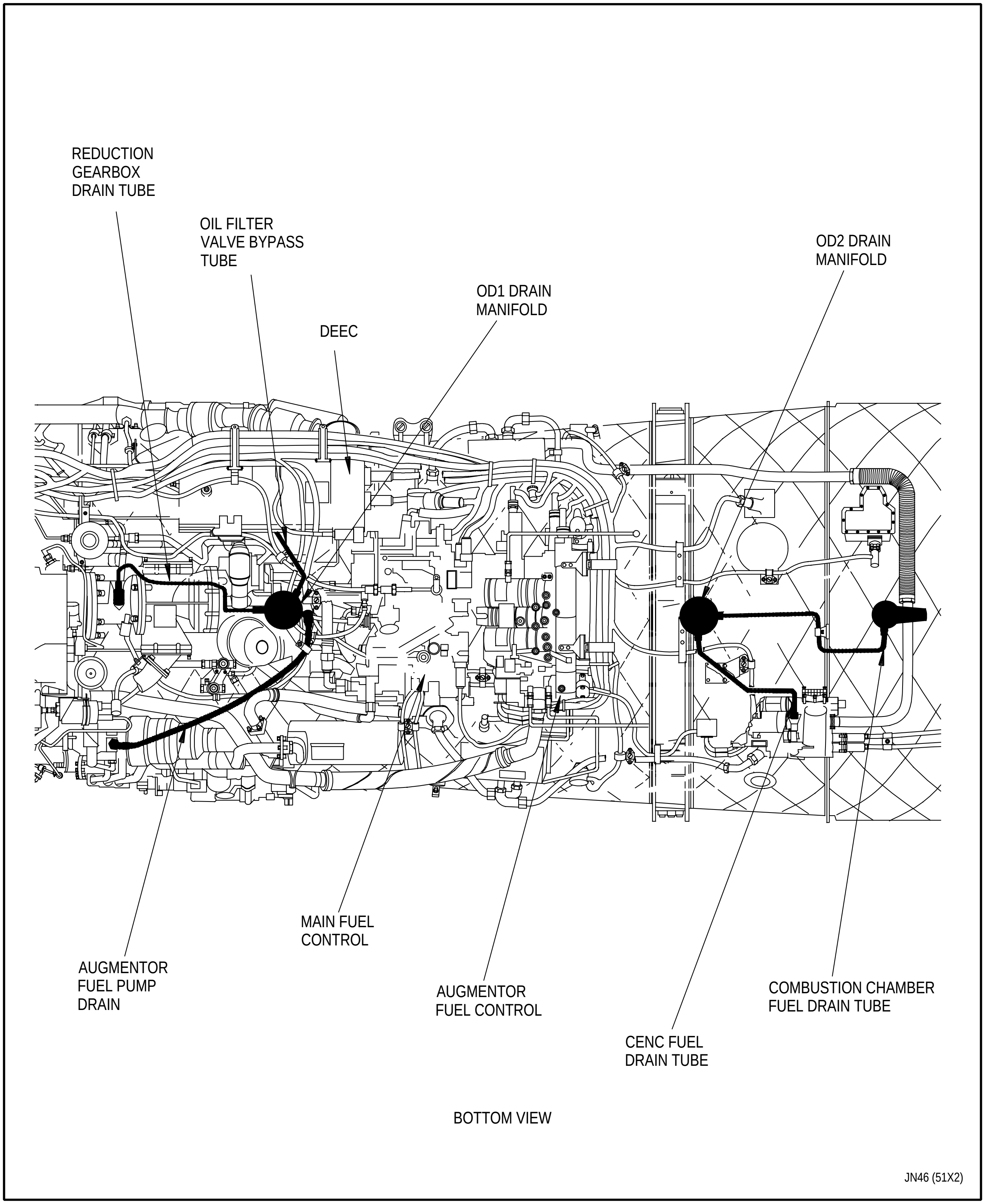


Figure 1. Tubes - Overboard Drain

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE NO-START

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 10

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 10	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Final Dress (After Installation Into AF 8624151 Thrust Stand)	WP 102 00
Engine Motoring	WP 110 00
Engine Start Procedures	WP 207 00
Engine Fuel System Contamination	WP 305 00
Engine Troubleshooting - General	WP 501 00
Augmentor Anomalies	WP 512 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Main Fuel Pump Fuel Pressure Analysis	WP 661 00
Ignition System Analysis	WP 664 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Pump - Fuel, Main Gear	WP 005 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Engine No-Start	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for engine no-start.

2. ENGINE NO-START.

(See Figures 1 and 2, and Table 1.)

a. Description:

(1) Engine does not begin combustion (indicated by no FTIT increase) after throttle is placed at IDLE during start attempt, or engine ignition time limits are exceeded. An engine no-start is usually due to lack of gas generator fuel or ignition.

Table 1. Engine No-Start

Step	Procedure	Result	Corrective Action
1.	If no N2 rpm indication during start attempt, perform following visual inspections. If N2 normal, go to step 2.		
	a. Check driveshaft shear section (See figure 1).	a.1. Driveshaft not sheared.	a.1. Go to b.
		a.2. Driveshaft sheared.	a.2. Replace PTO driveshaft. Perform b. before engine start attempt.
	b. Inspect fan inlet and turbine exhaust areas for damage or foreign objects.	b.1. No damage or foreign objects.	b.1. Go to c.
		b.2. Damage or foreign objects.	b.2. Perform complete borescope inspection.
	c. Check test cell N2 rpm instrumentation.	c.1. Instrumentation functions properly.	c.1. Go to step 2.
		c.2. Instrumentation does not function properly.	c.2. Repair instrumentation.
2.	Perform following visual inspections:		
	a. Perform engine rotation inspections.	a.1. Engine rotates freely.	a.1. Go to b.
	Core - Rotate input shaft on gearbox with wrench. Check for binding or unusual noises.	a.2. Engine does not rotate freely.	a.2. Tear down engine to repair damaged parts.
	Fan - Rotate 1st fan blades by hand.		
	b. Inspect for fuel leaks inside fan ducts.	b.1. No leaks.	b.1. Go to c.
		b.2. Fuel in fan ducts.	b.2. Repair fuel leak.

Table 1. Engine No-Start (continued)

Step	Procedure	Result	Corrective Action
	c. Check test cell starter gearbox for proper operation: • Coupling jaw alignment • Disengagement switch • Air starter pressure supply (SIP)	c.1. Test cell starter operates properly c.2. Test cell starter does not operate properly.	c.1. Go to step 3. c.2. Repair test cell.
3.	Check fuel supply to engine. Motor engine with ignition OFF and throttle at IDLE. Check for fuel fog from exhaust duct.	a. Fuel fog from exhaust duct during motoring. b. No fuel fog.	a. Go to step 4. b.1. Check following: 1. Throttle rigging. 2. Test cell fuel pump switches ON. 3. Fuel shut-off valve open. 4. Fuel present at MFP inlet. 5. Pfo pressure 25 to 65 psig. b.2. Perform engine MFP fuel pressure analysis.
4.	Check ignition system: a. Ensure test cell ignition switches ON.	a.1. Ignition lights illuminated. a.2. Ignition status light illuminated.	a.1. Go to b. a.2. Press switch to obtain status light.

Table 1. Engine No-Start (continued)

Step	Procedure	Result	Corrective Action
4.	Check ignition system: (Con't)		
	b. Check P119 for security, contamination, or damage	b.1. Connector serviceable.	b.1. Go to step 5
		b.2. Connector loose.	b.2. Secure P119 and repeat start attempt.
		b.3. Connector damaged or contaminated.	b.3. Use specified alcohol or freon degreaser to clean connectors. Replace ignition cable and/or generator stator as required.
5.	Check throttle linkage and ensure MFC PLA linkage secure and rotates smoothly.		
		a. PLA linkage serviceable.	a. Go to step 6.
		b. PLA linkage damaged	b. Replace MFC.
6.	Review event and fault data.		
		a. Events or faults	a. Troubleshoot individual event or fault codes.
		b. No events or faults	b. Go to step 7.
7.	Inspect MFP filter for contamination.		
		a. No contamination.	a. Go to step 8.
		b. Contamination	b. Troubleshoot fuel system contamination.

Table 1. Engine No-Start (continued)

Step	Procedure	Results	Corrective Action
8.	Check generator main ignition circuits. Perform following resistance checks (See figure 2):		
	a. CONN J119 PINS	a. Restance checks within limits:	a. Go to step 9.
	1. C to D	1. LT 10 OHMS	
	2. C to GND	2. GT 100,000 OHMS	
	3. D to GND	3. GT 100,000 OHMS	
	4. G to H	4. LT 10 OHMS	
	5. G to GND	5. GT 100,000 OHMS	
	6. H to GND	6. GT 100,000 OHMS	
		b. Resistance checks out of limits.	b. Replace generator.
9.	Check MFC ignition switch. Perform following resistance checks (See figure 2):		
	a. CONN J113 PINS	a. Resistance checks within limits:	a. Go to step 10.
	(PLA at CUTOFF)		
	1. A to B	1. LT 5 OHMS	
	2. A to GND	2. GT 100,000 OHMS	
	3. B to GND	3. GT 100,000 OHMS	
	4. D to E	4. LT 5 OHMS	
	5. D to GND	5. GT 100,000 OHMS	
	6. E to GND	6. GT 100,000 OHMS	
	(PLA at IDLE)		
	7. A to B	7. GT 100,000 OHMS	

Table 1. Engine No-Start (continued)

Step	Procedure	Results	Corrective Action
	Check MFC ignition switch. Perform following resistance checks (See figure 2): (Con't) (PLA at IDLE) CONN PINS J113 8. A to GND 9. B to GND 10. D to E 11. D to GND 12. E to GND	8.9. GT 100,000 OHMS GT 100,000 OHMS 10. GT 100,000 OHMS 11. GT 100,000 OHMS 12. GT 100,000 OHMS b. Resistance checks out of limits.	b. Replace MFC ignition switch module.
10.	Perform gas generator ignition system analysis.	a. System fails analysis. b. System passes analysis.	a. Replace ignition components as required. b. Go to step 11 before reinstalling igniters.
11.	Perform main igniter immersion depth check.	a. Immersion depth within limits. b. Immersion depth out of limits.	a. Go to step 12. b. Replace classified spacers as required.
12.	Perform start/leak functional check and check engine start. Replace components in following order until engine operates properly: •MFC metering valve EHV •MFC	a. Engine starts and operates properly. b. Engine does not start.	a. Return engine to service. b. Replace next component and repeat step 12.

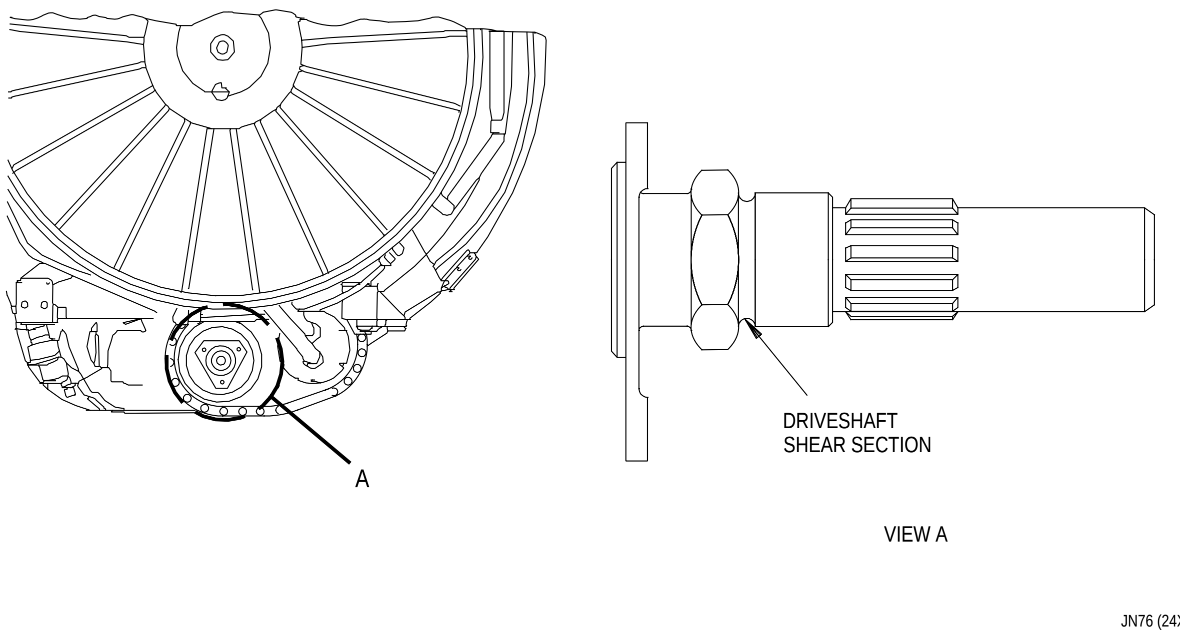
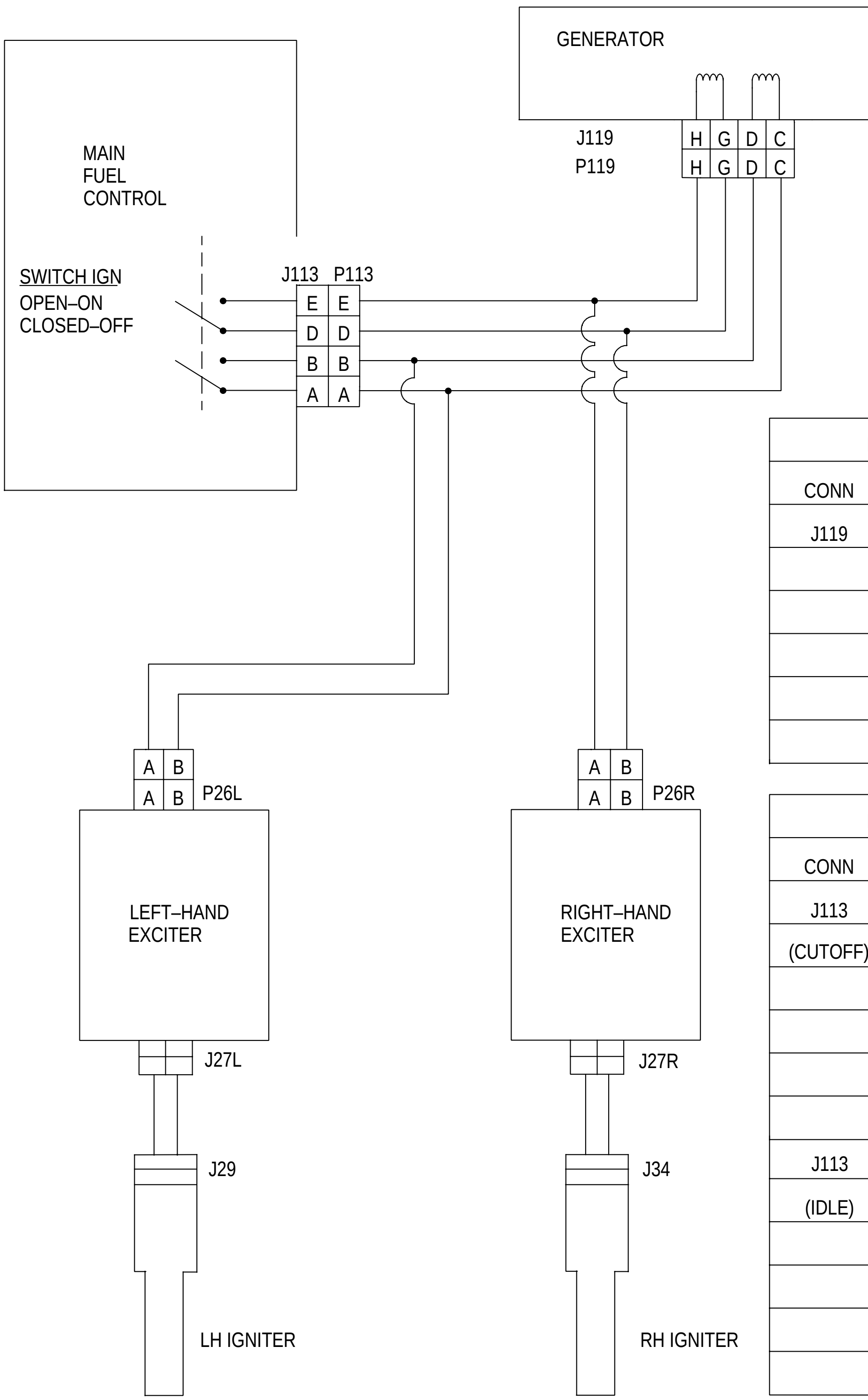


Figure 1. Starter Coupling Jaw - Inspection



RESISTANCE LIMITS		
CONN	PINS	OHMS
J119	C–D	LT 10
	C–GND	GT 100,000
	D–GND	GT 100,000
	G–H	LT 10
	G–GND	GT 100,000
	H–GND	GT 100,000

RESISTANCE LIMITS		
CONN	PINS	OHMS
J113	C–D	LT 5
(CUTOFF)	A–GND	GT 100,000
	B–GND	GT 100,000
	D–E	LT 5
	D–GND	GT 100,000
	E–GND	GT 100,000
J113	A–B	GT 100,000
(IDLE)	A–GND	GT 100,000
	B–GND	GT 100,000
	D–E	GT 100,000
	D–GND	GT 100,000
	E–GND	GT 100,000

JN31 (51X2)

Figure 2. Gas Generator/MFC Ignition System Schematic (Resistance Checks)

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE DIEOUT

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Final Dress (After Installation Into AF 8624151 Thrust Stand)	WP 102 00
Engine Start Procedures	WP 210 00
Engine Acceptance Test	WP 212 00
Acceleration/Deceleration Checks	WP 213 00
Engine Fuel System Contamination	WP 305 00
Engine Troubleshooting - General	WP 501 00
Augmentor Anomalies	WP 512 00
EPR vs. N1C2 Out of Limits, Intermediate (MIL) - Primary Mode	WP 515 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Pump - Fuel Main Gear	WP 005 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Engine Dieout	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for engine dieout.

2. ENGINE DIEOUT.

(See Figure 1 and Table 1.)

a. Description:

(1) Loss of combustion in gas generator section is usually associated with reduction or loss of gas generator fuel flow. Simultaneously decreasing N1, N2, and FTIT indicate engine dieout.

Table 1. Engine Dieout

Step	Procedure	Result	Corrective Action
1.	Perform following visual inspections:		
	a. Check driveshaft shear section (See figure 1).	a.1. Driveshaft not sheared.	a.1. Go to b.
		a.2. Driveshaft sheared.	a.2. Replace driveshaft. Perform b. before engine start attempt.
	b. Perform engine rotation inspections:	b.1. Engine rotates freely.	b.1. Go to step 2.
	Core - Rotate input shaft on gearbox with wrench. Check for binding or unusual noises.	b.2. Engine does not rotate freely.	b.2. Teardown engine to repair damaged parts.
	Fan - Rotate 1st fan blades by hand.	b.3. Binding or abnormal noises.	b.3. Tear down engine to repair damaged parts.
2.	Perform following visual inspections:		
	a. Inspect fan inlet and turbine exhaust areas for damage or foreign objects.	a.1. No damage or foreign objects.	a.1. Go to b.
		a.2. Damage or foreign objects.	a.2. Perform complete borescope inspection.
	b. Inspect for fuel leaks inside fan ducts.	b.1. No leaks.	b.1. Go to c.
		b.2. Fuel in fan ducts.	b.2. Repair fuel leak.
	c. Borescope rear compressor through AP 2 and AP 3 ports. Check for missing blades and abradable material.	c.1. No damage.	c.1. Go to step 3.
		c.2. Rear compressor damaged.	c.2. Replace core module.

Table 1. Engine Dieout (continued)

Step	Procedure	Result	Corrective Action
3.	Check throttle linkage		
	a. Ensure MFC PLA linkage secure and rotates smoothly.	a.1. PLA linkage serviceable.	a.1. Go to b.
		a.2. PLA linkage damaged.	a.2. Replace MFC.
	b. Check throttle rigging.	b.1. Rigging within limits.	b.1. Go to step 4.
		b.2. Rigging out of limits.	b.2. Rig throttle as required.
4.	Inspect MFP filter for contamination.	a. No contamination.	a. Go to step 5.
		b. Contamination.	b. Troubleshoot fuel system contamination.
5.	Attempt engine start.	a. Engine starts normally.	a. Go to step 6.
		b. Engine does not start normally.	b. Troubleshoot start anomaly or engine no-start, as required.
6.	Review event and fault data.	a. Events or faults.	a. Troubleshoot individual event or fault codes.
		b. No events or faults.	b. Go to step 7.
7.	Start engine. Stabilize 5 minutes. Check IDLE N1C2 rpm.	a. N1C2 4200 to 4400 rpm.	a. Go to step 8.
		b. N1C2 rpm out of limits.	b. Troubleshoot N1C2 rpm out of limits.
8.	Perform RCVV/CIVV schedule check.	a. RCVV/CIVV check within limits.	a. Go to step 9.
		b. RCVV/CIVV check out of limits.	b. Troubleshoot RCVV/CIVV out of limits.
9.	Perform acceleration/ deceleration functional check and check engine operation. Replace components in following order until engine operates properly:	a. Engine operates properly.	a. Return engine to service.
	• DEEC • MFC	b. Engine does not operate properly.	b. Replace component and repeat step 9.

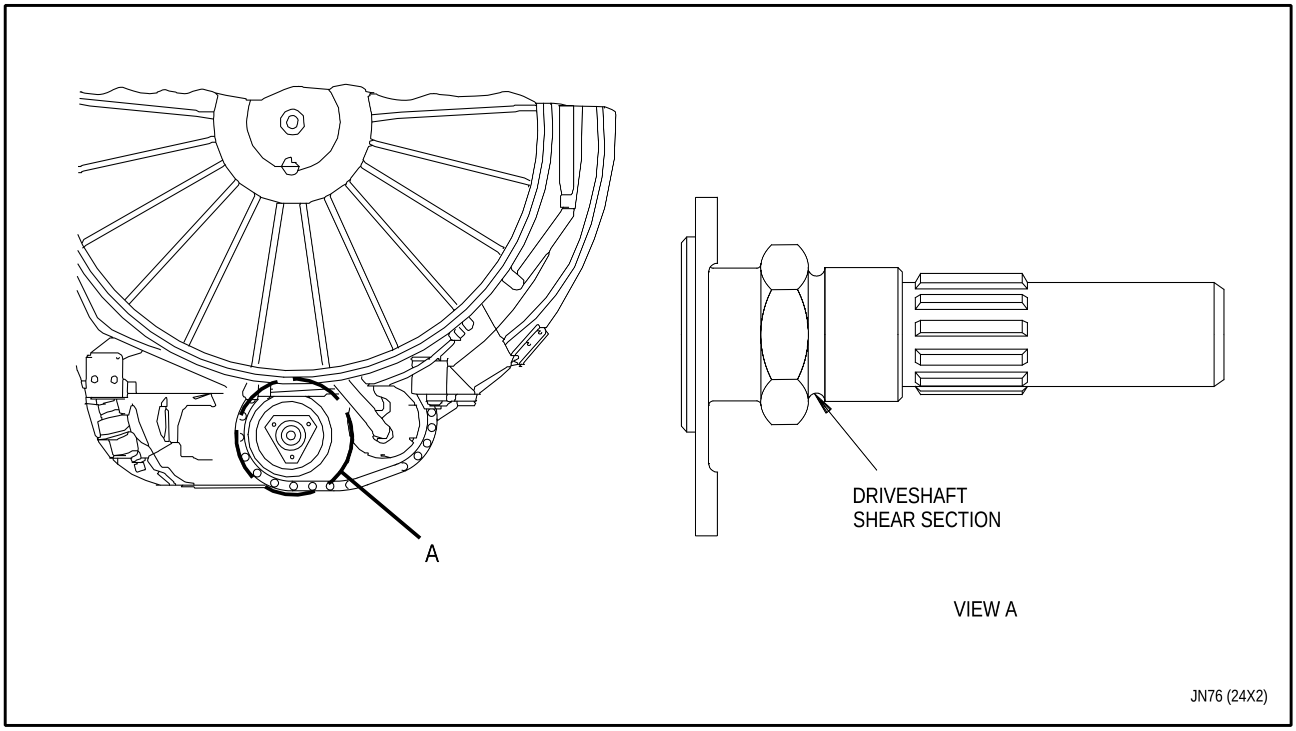


Figure 1. Starter Coupling Jaw - Inspection

WORK PACKAGE

TECHNICAL PROCEDURES

FTIT SYSTEM ANOMALY

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 10

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Start Procedures	WP 210 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedure Using EAU	WP 652 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	FTIT System Anomaly	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for FTIT system anomaly.

2. FTIT SYSTEM ANOMALY.

(See Figure 1, and Tables 1 and 2.)

a. Description:

(1) FTIT inconsistent with throttle position: FTIT circuits can be shorted or open. Open circuits are ignored by DEEC, but can cause excessive inaccuracy in FTIT value. Shorted probes form secondary junctions and transmit temperature at that junction. Usually this is lower than actual temperature. Improperly seated FTIT probes can also cause decreased temperature readings.

(2) FTIT exceeds maximum limit during steady state operation (without engine anomaly): FTIT overtemperature can be caused by engine control system as well as inaccurate FTIT readings.

(3) FTIT spread out of limits: FTIT spread problems can be caused by engine combsutor parts, as well as inaccurate FTIT readings.

Table 1. FTIT System Anomaly

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.		
		a. Events or faults.	a. Troubleshoot individual event or fault codes.
		b. No events or faults.	b. Go to step 2.
2.	Check FTITA and FTIT B circuits. Perform following resistance checks (See figure 1):		
	a. CONN P81 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	1. T to X	1. GT 100,000 OHMS	
	2. U to X	2. GT 100,000 OHMS	
	3. V to X	3. GT 100,000 OHMS	
	4. W to X	4. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace temperature cable.
	b. CONN P81 PINS	b.1 Resistance checks within limits:	b.1. Go to step 3.
	1. T to U	1. LT 20 OHMS	
	2. U to GND	2. GT 100,000 OHMS	
	3. T to GND	3. GT 100,000 OHMS	
	4. V to W	4. LT 20 OHMS	
	5. V to GND	5. GT 100,000 OHMS	
	6. W to GND	6. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2.a. If any of checks 1. thru 3. (FTITA) out of limits, perform c. on each probe below.
			FTIT Probe — CONN
			1 — P38
			3 — P40
			5 — P42
			7 — P44

Table 1. FTIT System Anomaly (continued)

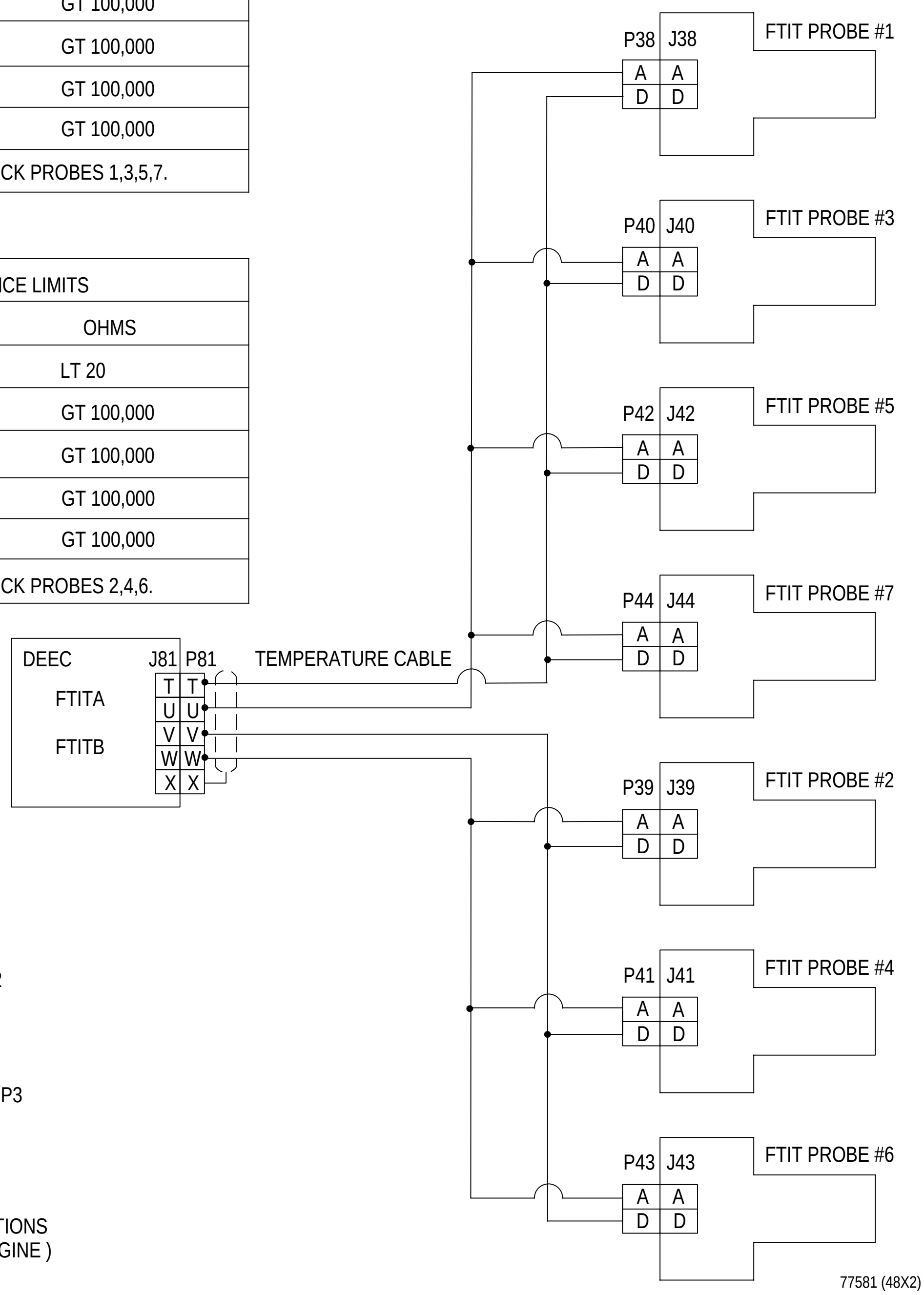
Step	Procedure	Result	Corrective Action
2. (cont'd)			b.2.b. If any of checks 4. thru 6. (FTITB) out of limits, perform c. on each probe below: FTIT Probe / Connector 2 / P39 4 / P41 6 / P43
	c. CONN J38-J44 / PINS 1. A to D 2. B to C 3. A to C 4. B to D 5. A to GND 6. B to GND 7. C to GND 8. D to GND	c.1. Resistance checks within limits: 1. LT 5 OHMS 2. LT 5 OHMS 3. GT 750,000 OHMS 4. GT 750,000 OHMS 5. GT 750,000 OHMS 6. GT 750,000 OHMS 7. GT 750,000 OHMS 8. GT 750,000 OHMS	c.1. Replace temperature cable.
		c.2. Resistance checks out of limits.	c.2. Replace FTIT out-of-limits probes.
	d. Reconnect P38 through P44. Perform resistance checks per figure 1 as follows: CONN P48 / PINS 1. 1 to 9 2. 2 to 9 3. 3 to 9 4. 4 to 9 5. 5 to 9 6. 6 to 9 7. 7 to 9 8. 8 to 9	d.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS 8. GT 100,000 OHMS	d.1. Go to e.
		d.2. Resistance checks out of limits.	d.2. Replace temperature cable per WP 003 00.

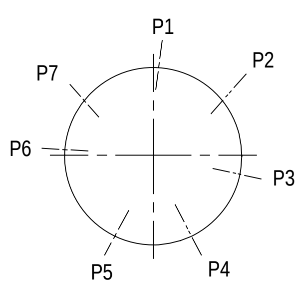
Table 2. FTIT System Anomaly (continued)

Step	Procedure	Result	Corrective Action
2. (cont'd)	e. CONN P48 PINS 1. 1 to 8 2. 2 to 8 3. 3 to 8 4. 4 to 8 5. 5 to 8 6. 6 to 8 7. 7 to 8 8. 8 to GND	e.1. Resistance checks within limits: 1. LT 20 OHMS 2. LT 20 OHMS 3. LT 20 OHMS 4. LT 20 OHMS 5. LT 20 OHMS 6. LT 20 OHMS 7. LT 20 OHMS 8. GT 100,000 OHMS	e.1. Go to step 3.
		e.2. Resistance checks out of limits.	e.2. Replace temperature cable per WP 003 00.
3.	Start engine and stabilize at IDLE for 9 minutes. Accelerate to Intermediate (MIL) PLA and stablize for 3 minutes. Compare CEDS FTITA and FTITB to test stand FTIT value. Shut down engine after check completed.	a. FTITA and FTITB within 18°F (10°C) of test cell FTIT value.	a.1. Temporarily connect temperature cable. If anomaly repeats, go to a.2. (below). a.2. Tighten FTIT probe harness caps on temperature cable and repeat step 3.
		b. FTITA and FTITB out of limits.	b.1. Check test cell instrumentation calibration. b.2. If instrumentation out of limits, repair test cell. b.3. If anomaly repeats, replace DEEC. b.4. Return engine to service.

FTITA RESISTANCE LIMITS	
PINS (P81)	OHMS
T TO U	LT 20
U TO GND	GT 100,000
T TO GND	GT 100,000
T TO X	GT 100,000
U TO X	GT 100,000
IF P81 CHECKS OUT OF LIMITS, CHECK PROBES 1,3,5,7.	

FTITB RESISTANCE LIMITS	
PINS (P81)	OHMS
V TO W	LT 20
V TO GND	GT 100,000
W TO GND	GT 100,000
V TO X	GT 100,000
W TO X	GT 100,000
IF P81 CHECKS OUT OF LIMITS, CHECK PROBES 2,4,6.	



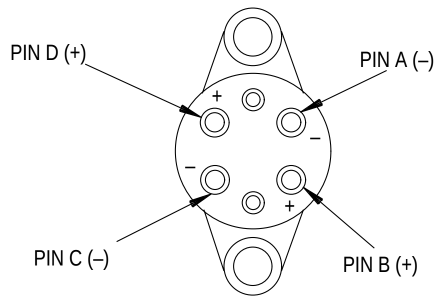


FTIT PROBE PHYSICAL LOCATIONS
(LOOKING FROM REAR OF ENGINE)

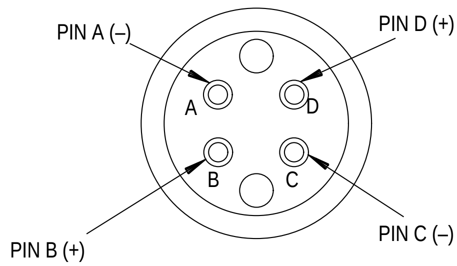
Figure 1. FTITA and FTITB Probe Circuits (Sheet 1 of 3)

NOTE

VERIFY FTIT PROBE PIN DESIGNATIONS BY COMPARING THEM TO LETTERED PINS IN HARNESS CAP



FTIT PROBE – TOP VIEW



FTIT HARNESS CAP – INSIDE VIEW

RESISTANCE LIMITS AT FTIT PROBE		
CONNECTORS	PINS	OHMS
J38 THRU J44	B TO C	LT 5
	B TO GND	GT 750,000
	C TO GND	GT 750,000
	A TO D	LT 5
	A TO GND	GT 750,000
	D TO GND	GT 750,000
	A TO C	GT 750,000
	B TO D	GT 750,000

JN43 (37X2)

Figure 1. FTITA and FTITB Probe Circuits (Sheet 2 of 3)

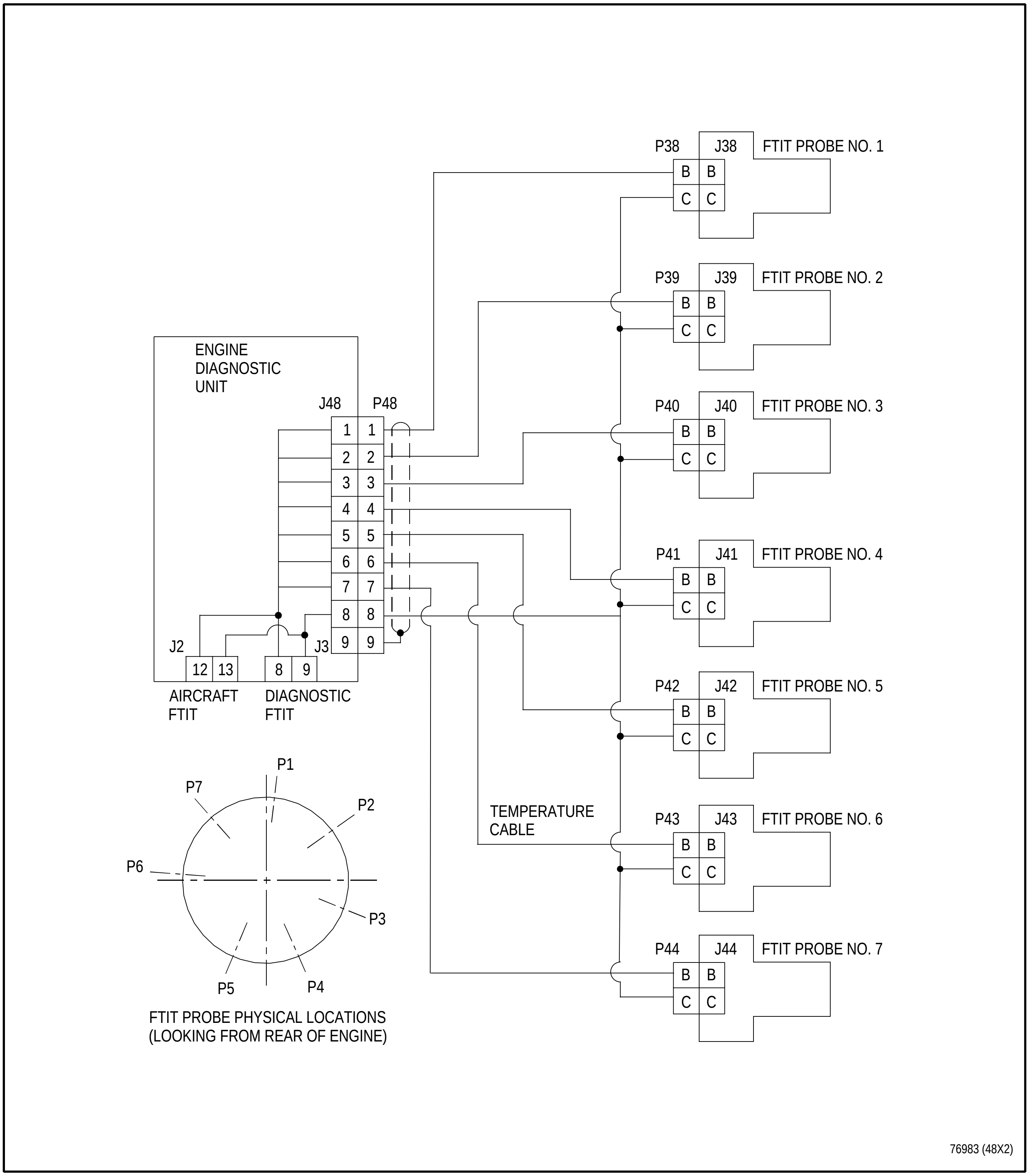


Figure 1. FTITA and FTITB Probe Circuits (Sheet 3 of 3)

WORK PACKAGE

TECHNICAL PROCEDURES

RCVV POSITION OUT OF LIMITS - PRIMARY MODE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	0	6 Blank	0		

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Reference Test Data	WP 226 00
System Fault Codes 4050 to 4054: RCVV System	WP 605 00
System Fault Codes 4080 to 4084: N1 System	WP 608 00
System Fault Codes 4090 to 4094: N2 System	WP 609 00
System Fault Codes 4100 to 4102: Tt2 System	WP 610 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Engine	T.O. 2J-F100-53-5
Blades - Compressor Rotor, Sixth, Seventh, and Eighth Stages; - Borescope Inspection	WP 024 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	RCVV Position Out of Limits - Primary Mode	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for RCVV position out of limits in primary mode.

2. RCVV POSITION OUT OF LIMITS - PRIMARY MODE.

(See Figure 1 and Table 1.)

a. Description:

(1) RCVV angle vs. N2C2.5 is out of limits. The DEEC positions RCVVs as function of N2 rpm and Tt2.5, which DEEC calculates using Tt2 and N1 rpm. Sensor or test cell instrumentation errors usually cause RCVV scheduling problems.

(2) Use of engine anti-ice system will cause test cell Tt2.5 value, but not DEEC-calculated Tt2.5 value, to increase. If anti-ice required, do not check RCVV position, except as noted.

Table 1. RCVV Position Out Of Limits - Primary Mode

Step	Procedure	Result	Corrective Action
1.	Check instrumentation:		
	a. Compare test cell N1, N2, and Tt2 instrumentation to DEEC N1SEN, N2SEN, and Tt2LL values using EMSE:	a.1. N1 and N2 rpm within limits.	a.1. Go to step 2.
		a.2. N1, N2 rpm, and/or Tt2 out of limits.	a.2. Check N1, N2 rpm, and Tt2 instrumentation calibration. If test cell calibration within limits, do the following:
	• N1 (Word 28)		• If N1 value out of limits, troubleshoot System Fault Code 4081.
	• N2 (Word 29)		• If N2 value out of limits, troubleshoot System Fault Code 4091.
	• Tt2 (Word 54)		• If Tt2 value out of limits, troubleshoot System Fault Code 4102.
2.	With engine at out-of-limits RCVV point, manually calculate N2C2.5.	a. N2C2.5 value within limits.	a. Go to step 3.
		b. N2C2.5 value out of limits.	b.1. Check test cell Tt2.5 probe installation.
			b.2. Calibrate or replace test cell instrumentation.
3.	If RCVVs are low (axial) out of limits, remove cover from AP2 borescope port. Check AP2 port inner plug for security or signs of hot air leakage (See figure 1).	a. Plug secure.	a. Troubleshoot engine per System Fault Code 4052.
		b. Plug not secure.	b. Replace AP2 borescope plug.

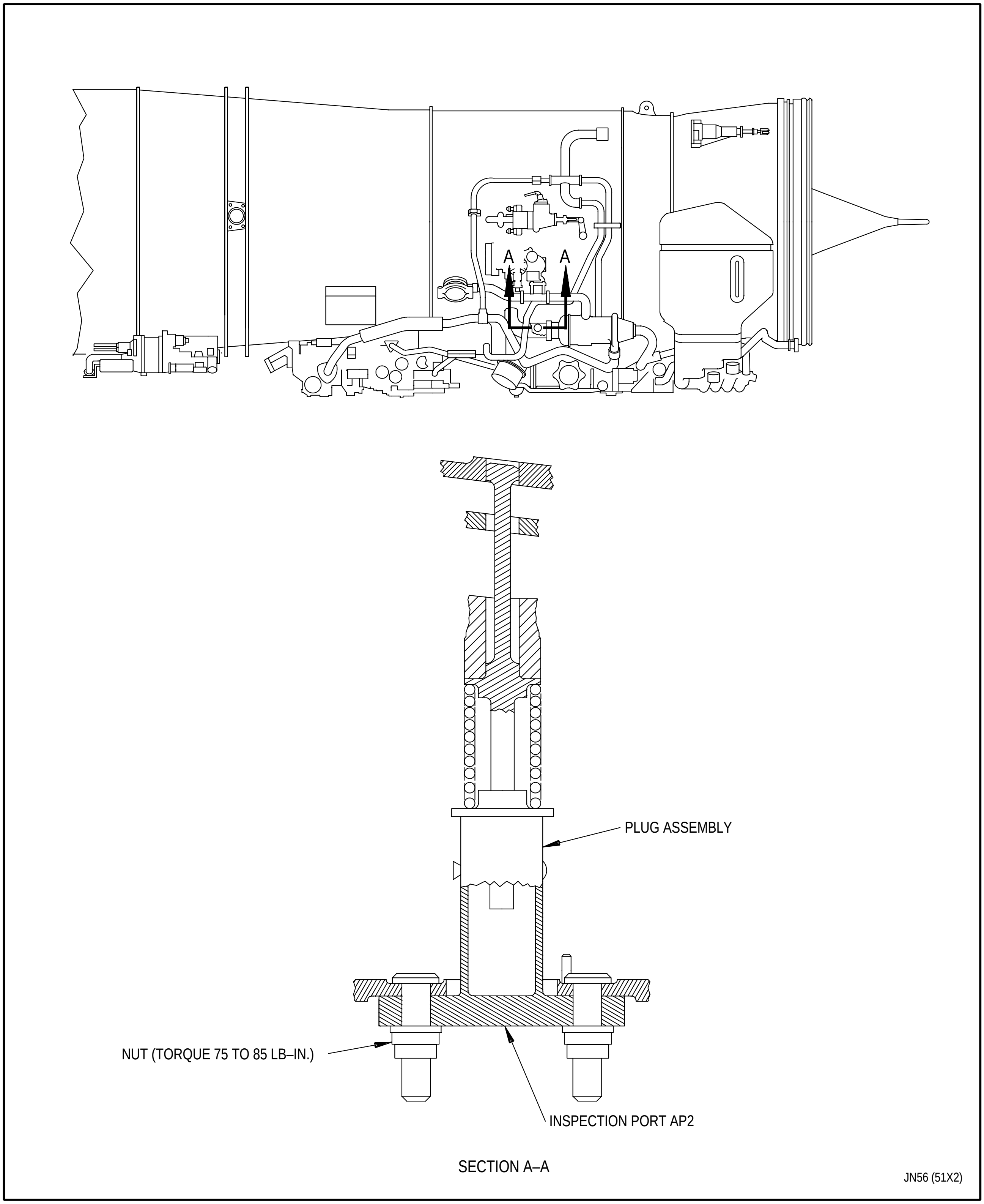


Figure 1. AP2 High Compressor Mid-stage - Inspection Port

WORK PACKAGE

TECHNICAL PROCEDURES

CIVV POSITION OUT OF LIMITS - PRIMARY MODE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	0	6 Blank	0		

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Acceptance Test	WP 212 00
Reference Test Data	WP 226 00
Engine Troubleshooting - General	WP 501 00
System Fault Code 4010 to 4012: CIVV System	WP 602 00
System Fault Codes 4080 to 4084: N1 System	WP 608 00
System Fault Codes 4100 to 4102: Tt2 System	WP 610 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedure Using EAU	WP 652 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Inlet Fan Module	T.O. 2J-F100-53-6
Compressor Inlet Variable Vane Cylinder System - Rigging	WP 705 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for CIVV position out of limits in primary mode.

2. CIVV POSITION OUT OF LIMITS - PRIMARY MODE.

(See Table 1.)

a. Description:

(1) CIVV angle vs. N1C2 out of check band limits: The DEEC positions CIVV as a function of N1 rpm and Tt2. Sensor or test cell instrumentation errors usually cause CIVV scheduling problems.

Table 1. CIVV Position Out Of Limits - Primary Mode

Step	Procedure	Result	Corrective Action
1.	Check instrumentation:		
	a. Compare test cell N1 rpm and Tt2 instrumentation to EMSE:	a.1. N1 rpm and Tt2 within limits.	a.1. Go to step 2.
		a.2. N1 rpm and/or Tt2 out of limits.	a.2. Check N1 rpm and Tt2 instrumentation calibration. If test cell calibration within limits, do the following:
	• N1 (Word 28)		• If N1 rpm value out of limits, troubleshoot System Fault Code 4081.
	• Tt2 (Word 54)		• If Tt2 value out of limits, troubleshoot System Fault Code 4102.
	b. Compared Tt2A vs. Tt2B individual circuit inputs using EMSE>	b.1. Individual Tt2 circuit values within limits.	b.1. Go to step 2.
		b.2. Individual circuit values out of limits.	b.2. If Tt2 value out of limits, troubleshoot System Fault Code 4102.
2.	With engine at out of limits CIVV point, manually calculate N1C2.	a. N1C2 within limits.	a. Go to step 3.
		b. N1C2 out of limits.	b.1. Check N1 circuit.
			b.2. Recalibrate or replace test cell instrumentation.
3.	Perform CIVV system functional checks.	a. CIVV system functions normally.	a. Go to step 4.
		b. CIVV system does not function normally.	b. Repair or replace CIVV parts, as required.

Table 1. CIVV Position Out Of Limits - Primary Mode (continued)

Step	Procedure	Result	Corrective Action
4.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 5.
5.	Perform CIVV schedule check using DEEC-requested CIVV position (word 37).	a. CIVV schedule within limits.	a. Check CIVV master actuator. Troubleshoot System Fault Code 4011.
		b. CIVV schedule out of limits.	b. Go to step 6.
6.	Perform CIVV schedule check and check engine operation. Replace components in following order until engine operates properly:	a. CIVV schedule within limits.	a. Return engine to service.
	• CIVV EHV • DEEC • CIVV Master Actuator	b. CIVV schedule out of limits.	b. Replace next component and repeat steps 5 and 6.

WORK PACKAGE

TECHNICAL PROCEDURES

N2 or N2C2.5 vs. Tt2 OUT OF LIMITS - SECONDARY MODE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Final Dress (After Installation Into AF 8624151 Thrust Stand)	WP 102 00
Engine Acceptance Test	WP 212 00
Engine Troubleshooting - General	WP 501 00
Exhaust Nozzle Position Out of Limits - Primary Mode	WP 513 00
EPR vs N1C2 Out of Limits, Intermediate (MIL) Power - Primary Mode	WP 515 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Control - Push-Pull, Rear Compressor Variable Vane Feedback - Rigging	WP 102 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for N2 or N2C2.5 vs Tt2 out of limits in Secondary Mode.

2. N2 or N2C2.5 vs Tt2 OUT OF LIMITS - SECONDARY MODE.

(See Figure 1 and Table 1.**)**

a. Description:

(1) N2 or N2C2.5 vs Tt2 is out of check band limits during Secondary Mode IDLE functional acceptance test.

(2) N2 vs Tt2 is out of check band limits during Secondary Intermediate (MIL) functional acceptance test.

Table 1. N2 or N2C2.5 vs Tt2 Out of Limits - Secondary Mode

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults.	a. Troubleshoot individual event or fault codes.
		b. No events or faults.	b. Go to step 2.
2.	Ensure borescope plugs installed correctly.	a. Borescope plugs installed correctly.	a. Go to step 3.
		b. Borescope plugs not installed correctly.	b. Repair as required and repeat Secondary Mode functional check.
3.	Check throttle linkage:		
	a. Ensure MFC PLA linkage secure and rotates smoothly.	a.1. PLA linkage serviceable.	a.1. Go to b.
		a.2. PLA linkage damaged.	a.2. Replace MFC.
	b. Check throttle rigging.	b.1. Throttle rigged properly.	b.1. Go to step 4.
		b.2. Throttle out of rig.	b.2. Rig throttle.
4.	Check MFC Tt2 sensor:		
	a. Inspect fan inlet case probe for damage and proper installation.	a.1. No discrepancies.	a.1. Go to b.
		a.2. Fan inlet case probe damaged or installed improperly.	a.2. Repair or replace MFC.
	b. Inspect armored capillary tube for bends, kinks, and chafes.	b.1. Capillary tube serviceable.	b.1. Go to step 5.
		b.2. Capillary tube damaged.	b.2. Replace MFC Tt2 sensor assembly.
5.	Check MFC Ps2 sensor line plumbing for leaks, loose fittings, chafes or blocks (See figure 1).	a. Plumbing serviceable.	a. Go to step 6.
		b. Plumbing not serviceable.	b. Repair plumbing.

Table 1. N2 or N2C2.5 vs Tt2 Out of Limits - Secondary Mode (continued)

Step	Procedure	Result	Corrective Action
6.	Perform following checks:		
	a. Check RCVV feedback cable rigging.	a.1. RCVV feedback cable rigged properly.	a.1. Go to b.
		a.2. RCVV feedback cable out of rig.	a.2. Rig RCVV feedback cable.
	b. Perform RCVV system actuation torque check.	b.1. RCVV linkage movement normal.	b.1. Go to step 7.
		b.2. RCVV linkage movement not normal.	b.2. Replace RCVV feedback cable or MFC as required.
7.	Perform thrust parameter check.	a. Thrust parameter within limits.	a. Go to step 8.
		b. Thrust parameter out of limits.	b. Troubleshoot N1C2 vs. EPR out of limits.
8.	Tranfer to Secondary Mode. Position mode select switch to SECONDARY mode.	a. ENP 0° or less.	a. Go to step 9.
		b. ENP more than 0°.	b. Troubleshoot ENP out of limits - Secondary Mode.
9.	Perform Secondary Mode schedule check.	a. RCVV schedule out of limits.	a. Troubleshoot anomaly.
		b. RCVV schedule within limits.	b. Replace MFC.

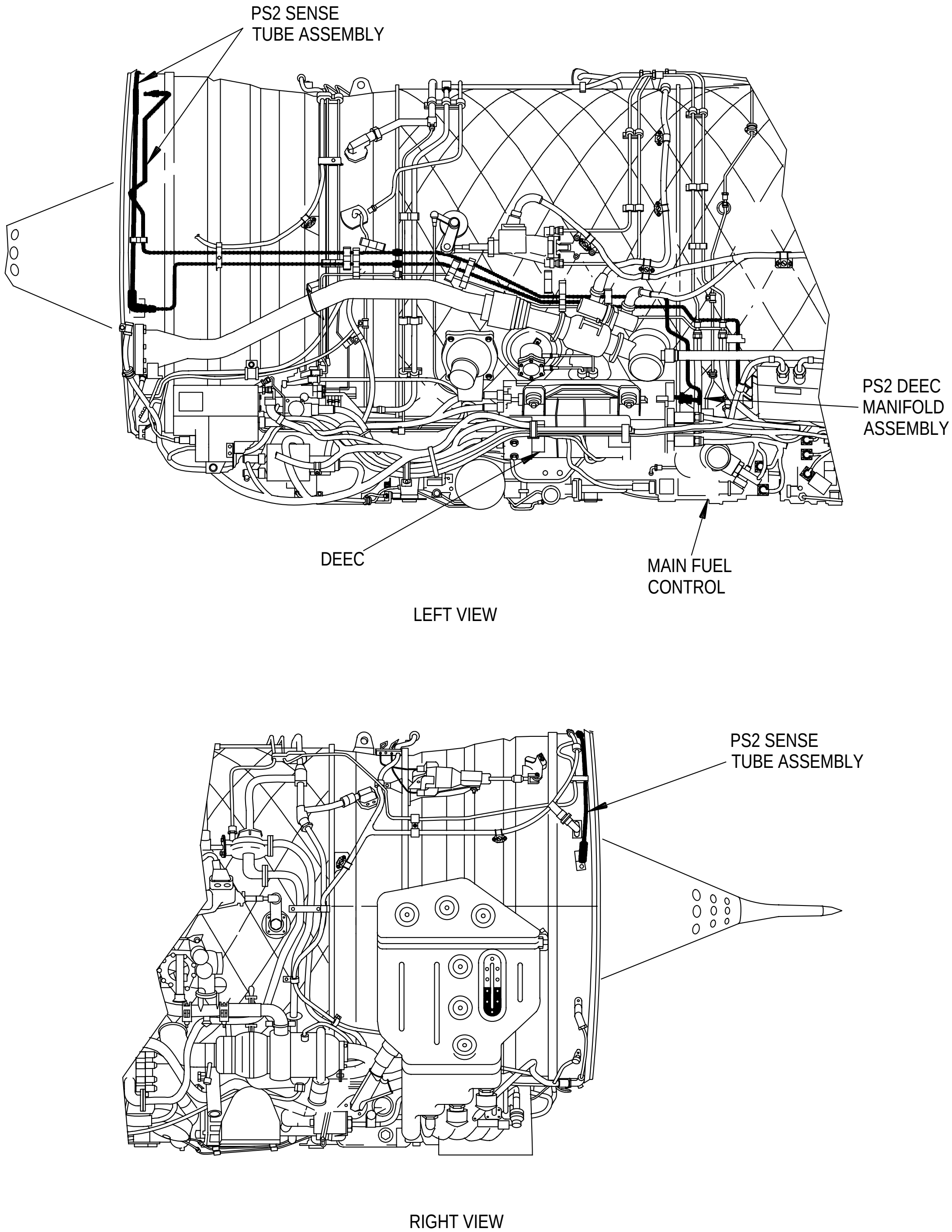


Figure 1. Ps2 Sense Line - Inspection

WORK PACKAGE

TECHNICAL PROCEDURES

N1 OVERSPEED

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	0				
6 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Acceleration/Deceleration Checks	WP 213 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Main Fuel Pump Pressure Analysis	WP 661 00
Inlet Fan Module	T.O. 2J-F100-53-6
Compressor Inlet Variable Vane Cylinder System - Rigging	WP 705 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for N1 rpm overspeed.

2. N1 OVERSPEED.

(See Table 1.)

a. Description:

NOTE

If N1 rpm overspeed occurs in conjunction with an N2 rpm overspeed and/or an FTIT overtemperature, troubleshoot FTIT overtemperature, then N2 rpm overspeed, before troubleshooting N1 rpm overspeed.

(1) N1 rpm exceeds maximum N1 rpm limit schedule.

(2) N1 rpm predicted to exceed maximum N1 rpm limit schedule. Engine may transfer to Secondary Mode if overspeed is detected.

Table 1. N1 Overspeed

Step	Procedure	Result	Corrective Action
		CAUTION If maximum N1 rpm exceeded 12,400, do not operate engine.	
1.	Determine if engine N1 rpm limits have been exceeded.	a. Maximum N1 rpm less than 11,500.	a. Go to step 2.
		b. Maximum N1 rpm 11,500 to 12,400.	b.1. Troubleshoot N1 overspeed.
			b.2. Record Maximum N1 rpm in Fan and FDT module AFTO 44 forms.
		c. Maximum N1 rpm exceeded 12,400.	c.1. Troubleshoot N1 overspeed.
			c.2. Record maximum N1 rpm in Fan and FDT module AFTO 44 forms.
			c.3. Reject Fan and FDT modules for N1 overspeed inspection.
2.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 3.
3.	Perform CIVV functional checks.	a. CIVV system functions properly.	a. Go to step 4.
		b. CIVV system does not function properly.	b. Repair CIVV system parts, as required.
4.	Perform MFP fuel pressure analysis.	a. Fuel pressures within limits.	a. Go to step 5.
		b. Fuel pressures out of limits.	b. Replace MFP.
5.	Start engine in Primary Mode. With engine at IDLE cycle exhaust nozzle switch: RESET-OFF-RESET.	a. Exhaust nozzle operates normally.	a. Go to step 6.
		b. Exhaust nozzle does not operate normally.	b. Repair augmentor parts, as required.

Table 1. N1 Overspeed (continued)

Step	Procedure	Result	Corrective Action
6.	a. Check DEEC pressure transducers. Start engine and move throttle to Intermediate (MIL). Stabilize 3 minutes. Compare Pt6, Pb and Ps2 values between EMSE and test cell instrumentation.	a. Values within limits: 1. Pt6 within ±.5 in HgA. 2. Pb within±5 psia. 3. Ps2 within.3 psid.	a. Go to step 7.
	b. Move throttle to IDLE and shut down engine after test completed.	b. Pt6, Pb, or Ps2 value out of limits.	b. Remove DEEC for out-of-limits transducer change.
7.	Perform acceleration/ deceleration functional check and check engine operation. Replace components in following order until engine operates properly: • CIVV EHV • CENC EHV • DEEC • MFC	a. N1 rpm overspeed does not repeat.	a. Return engine to service.
		b. N1 rpm overspeed repeats.	b. Replace next component and repeat step 7.

WORK PACKAGE

TECHNICAL PROCEDURES

N2 OVERSPEED

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	0				
6 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00
Acceleration/Deceleration Checks	WP 213 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Main Fuel Pump Fuel Pressure Analysis	WP 661 00
Compressor Bleed System Functional Check	WP 667 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Control - Push-Pull, Rear Compressor Variable Vane Feedback - Rigging	WP 102 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for N2 rpm overspeed.

2. N2 OVERSPEED.

(See Table 1.)

a. Description:

(1) N2 rpm exceeds or is predicted to exceed maximum N2 rpm limit (actual N2 combined with rate of increase) and engine transfers to Secondary Mode.

Table 1. N2 Overspeed

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults. b. No events or faults.	a. Troubleshoot individual event or fault codes. b. Go to step 2.
2.	Determine if engine N2 rpm overspeed limits have been exceeded.	a. N2 rpm within limits. b. N2 rpm out of limits.	a. Return engine to service. b. Go to step 3.
3.	Perform following checks: a. Check RCVV feedback cable rigging. b. Perform RCVV system actuation torque check.	a.1. RCVV feedback cable rigged properly. a.2. RCVV feedback cable out of rig. b.1. RCVV linkage movement normal. b.2. RCVV linkage movement not normal.	a.1. Go to b. a.2. Rig RCVV feedback cable. b.1. Go to step 4. b.2. Replace RCVV feedback cable or MFC as required.
4.	Perform compressor bleed valve functional check.	a. Valve functions properly. b. Valve does not function properly.	a. Inspect start bleed actuation system. Repair or replace parts as required. b. Go to step 5.
5.	Perform MFP pressure analysis.	a. Fuel pressures out of limits. b. Fuel pressures within limits.	a. Replace MFP. b. Go to step 6.
6.	Check DEEC pressure transducers. Start engine and move throttle to Intermediate (MIL). Stabilize 3 minutes. Compare Pt6, Pb, and Ps2 values between EMSE and test cell instrumentation. Move throttle to IDLE and shut down engine.	a. Values within limits: 1. Pt6 within ±.5 in Hga 2. Pb within ±5 psia 3. Ps2 within .3 psid. b. Pt6, Pb and Ps2 values out of limits.	a. Go to step 7. b. Remove DEEC for out-of-limits transducer change.

Table 1. N2 Overspeed (continued)

Step	Procedure	Result	Corrective Action
7.	Perform accel/decel functional check and check engine operation. Replace components in the following order until engine operates properly. •MFC •DEEC •Core module	a. N2 rpm overspeed does not repeat.	a. Return engine to service.
		b. N2 rpm overspeed repeats.	b. Replace next component and repeat step 7.

WORK PACKAGE

TECHNICAL PROCEDURES

FTIT SPREAD OUT OF LIMITS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 10

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 9	0				
10 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Introduction - Engine Test Procedures	WP 002 00
Engine Start Procedures	WP 210 00
Engine Troubleshooting - General	WP 501 00
EDU Test Procedure Using EAU	WP 650 00
Downloading and Reviewing Data Using CEDS	WP 651 00
On-Condition Maintenance	T.O. 2J-F100-53-2

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	FTIT Spread Out of Limits	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains a description and a troubleshooting procedure for FTIT spread out of limits.

b. Operation:

(1) The FTIT probes, measure temperature at the fan drive turbine inlet. They also provide a representative signal to the DEEC for engine control and to the EDU for diagnostic purposes and for transmission to engine and airframe electrical interface.

(2) The seven probes are flange-mounted around the rear fan duct. The probes elements are installed in the 3rd stage turbine vanes. A hole passes from vane pressure to suction side to allow hot turbine gases to pass over the probe tips.

(3) Each probe contains two ungrounded, electrically isolated chromel-alumel thermocouple junctions: One junction from each probe is used by the EDU; the other is used by the DEEC.

2. FTIT SPREAD OUT OF LIMITS.

(See Figures 1 and 2 and Table 1.)

a. FTIT spread problems can be caused by engine combustor section components as well as inaccurate FTIT readings.

b. Fuel nozzle affecting probes 1, 2, and 7 may be removed/replaced by going through fuel/oil cooler ports in outer fan duct.

c. When replacing nozzles, choose lower flowing nozzle for the hot probe and higher flowing nozzles for the cold probe, if possible.

d. Troubleshoot FTIT out of limits per table 1.

Table 1. FTIT Spread Out of Limits

Step	Procedure	Result	Corrective Action
1.	Check FTIT individual probe circuits. Perform the following resistance checks (See figure 1):		
	a. CONN. P48 / PINS 1. 1 to 8 2. 2 to 8 3. 3 to 8 4. 4 to 8 5. 5 to 8 6. 6 to 8 7. 7 to 8 8. 8 to GND	a.1. Resistance checks within limits: 1. LT 20 OHMS 2. LT 20 OHMS 3. LT 20 OHMS 4. LT 20 OHMS 5. LT 20 OHMS 6. LT 20 OHMS 7. LT 20 OHMS 8. GT 100,000 OHMS	a.1. Go to step 2.
		a.2. Resistance checks out of limits.	a.2. Remove FTIT probe caps from faulty circuits. Go to b.
	b. CONN J38-J44 / PINS 1. A to D 2. B to C 3. A to GND 4. B to GND 5. A to C	b.1. Resistance checks within limits: 1. LT 5 OHMS 2. LT 5 OHMS 3. GT 750,000 OHMS 4. GT 750,000 OHMS 5. GT 750,000 OHMS	b.1. Replace temperature cable.
		b.2. Resistance checks out of limits.	b.2. Replace FTIT probes as required.
2.	Start engine and repeat spread check.	a. FTIT spread within limits.	a. Return engine to service.
		b. FTIT spread out of limits.	b. Go to step 3.
3.	Interchange FTIT probes which had highest reading with probe which had lowest reading. Check probe for proper seating and depth. Repeat spread checks.	a. Hot and cold locations change.	a. Replace low reading FTIT probe and repeat step 2.
		b. Hot and cold locations do not change.	b. Go to step 4.
4.	Borescope core module at AP4 and AP6.	a. Core module within limits.	a. Go to step 5.
		b. Core module out of limits.	b. Repair or replace core module components. Replace fuel nozzles.

Table 1. FTIT Spread Out of Limits (continued)

Step	Procedure	Result	Corrective Action
5.	If spread is excessive, replace fuel nozzles (2 at each location) effecting both the hot and cold FTIT probes (See figure 2). Also inspect fuel manifold for cracks and coking and replace if necessary.	a. FTIT spread within limits.	a. Return engine to service.
		b. FTIT spread out of limits.	b. Go to step 6.
6.	Replace components in followng order to correct FTIT spread out of limits. Start engine and repeat spread check: • Combustor • Diffuser • Fan drive turbine • Core	a. FTIT spread within limits.	a. Return engine to service.
		b. FTIT spread out of limits.	b. Change next component and repeat step 6.

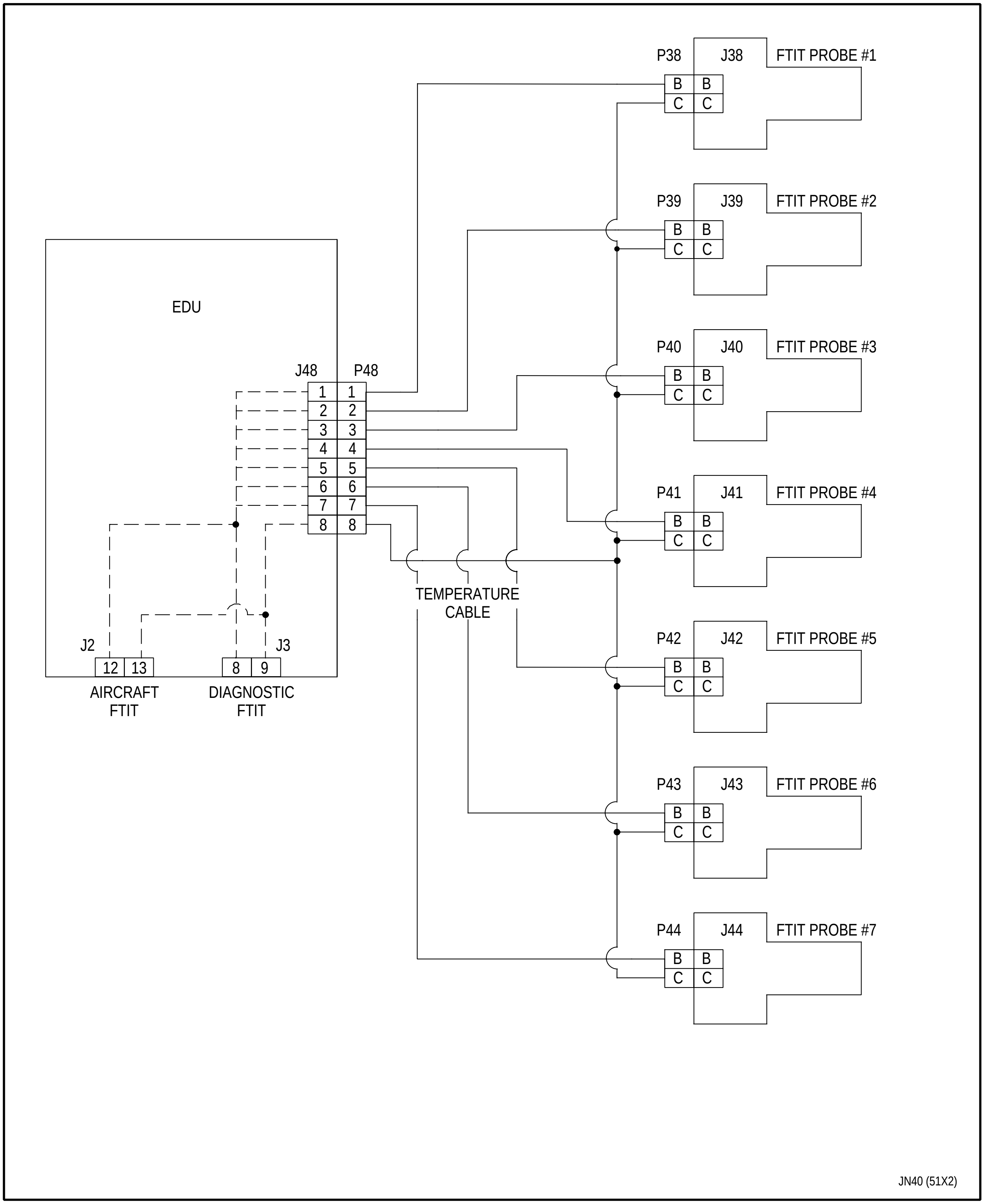


Figure 1. FTIT Indicator Circuit (Sheet 1 of 3)

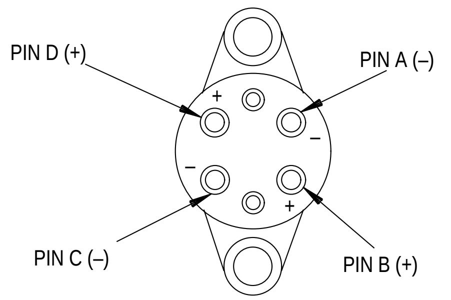
FTIT INDICATOR CIRCUIT RESISTANCE LIMITS		
ALL PROBES	P48	OHMS
	8-GND	GT 100,000
PROBE 1	1-8	LT 20
PROBE 2	2-8	LT 20
PROBE 3	3-8	LT 20
PROBE 4	4-8	LT 20
PROBE 5	5-8	LT 20
PROBE 6	6-8	LT 20
PROBE 7	7-8	LT 20

JN41 (30X2)

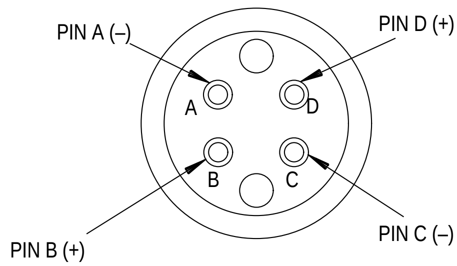
Figure 1. FTIT Indicator Circuit (Sheet 2 of 3)

NOTE

VERIFY FTIT PROBE PIN DESIGNATIONS BY COMPARING THEM TO LETTERED PINS IN HARNESS CAP



FTIT PROBE – TOP VIEW



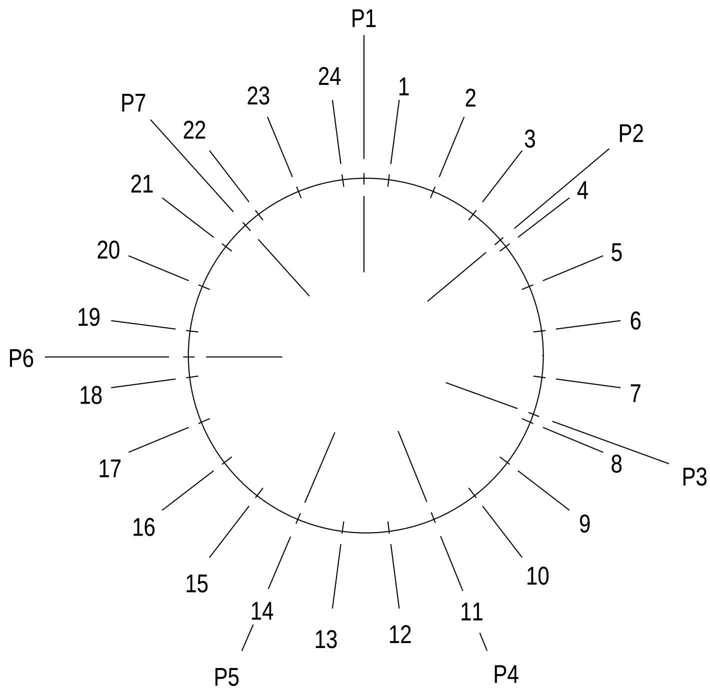
FTIT HARNESS CAP – INSIDE VIEW

RESISTANCE LIMITS AT FTIT PROBE		
CONNECTORS	PINS	OHMS
J38 THRU J44	B TO C	LT 5
	B TO GND	GT 750,000
	C TO GND	GT 750,000
	A TO D	LT 5
	A TO GND	GT 750,000
	D TO GND	GT 750,000
	A TO C	GT 750,000
	B TO D	GT 750,000

JN43 (37X2)

Figure 1. FTIT Indicator Circuit (Sheet 3 of 3)

DIAGRAM OF FUEL NOZZLE POSITIONS (1 THRU 24)
7 FTIT PROBES (P1 THRU P7)



NOTE

FUEL NOZZLE RELATIONSHIP TO FTIT PROBES:

FTIT PROBE POSITION	FUEL NOZZLES AFFECTING PROBE
P1	22,23,24
P2	1,2,3
P3	4,5,6
P4	9,10,11
P5	12,13,14
P6	16,17,18
P7	19,20,21

JN44 (37X2)

Figure 2. FTIT Probe and Fuel Nozzle Position

WORK PACKAGE

TECHNICAL PROCEDURES

AUGMENTOR SPRAYRING LEAKAGE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 3	0				
4 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Acceleration/Deceleration Checks	WP 213 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

This work package provides troubleshooting procedures for augmentor sprayring leakage into augmentor duct.

2. AUGMENTOR SPRAYRING LEAKAGE.

(See Table 1.)

a. Description:

(1) Fuel leakage past augmentor fuel control (AFC) segment selector shutoff valves will drain through the augmentor sprayrings into the augmentor duct.

(2) Incomplete fuel scavenging from augmentor sprayrings will cause sprayrings to leak after shutdown.

b. Engine Symptoms:

(1) Fuel in augmentor duct

(2) Fuel dripping from augmentor sprayrings

Table 1. Augmentor Sprayring Leakage

Step	Procedure	Result	Corrective Action
NOTE Augmentor sprayrings not properly scavenged (one-minute Intermediate (MIL) run) will leak.			
1.	Perform acceleration/ deceleration functional checks. Stabilize at least one minute at Intermediate (MIL) before shutdown. Check augmentor sprayrings for leaks.	a. Augmentor sprayrings. Allowable leakage per segment 20 drops/1cc per minute. Total leakage (all segments) 150 drops/7.5cc per minute.	a. Return engine to service.
		b. Augmentor sprayrings. Leakage out-of-limits.	b. Replace AFC and repeat Step 1.

WORK PACKAGE

TECHNICAL PROCEDURES

ABNORMAL ENGINE NOISE OR VIBRATION (NON-AUGMENTED)

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Start Procedures	WP 210 00
Engine Shutdown	WP 225 00
Engine No-Start	WP 534 00
Engine Dieout	WP 535 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for abnormal engine noise or vibration (non-augmented).

2. ABNORMAL ENGINE NOISE OR VIBRATION (NON-AUGMENTED).

(See Table 1.)

a. Description:

(1) Any unusual noise or vibration with a set or given frequency, such as engine rumbling, shaking, or buzzing.

Table 1. Abnormal Engine Noise or Vibration (Non-Augmented)

Step	Procedure	Result	Corrective Action
1.	Ensure vibration mounts, accelerometers, and cables properly installed and secure.	a. Components not properly installed and secure.	a. Repair or replace equipment. Repeat engine parameters where vibration occurred. If problem still exists, go to step 2.
		b. Components properly installed and secure.	b. Go to step 2.
2.	Inspect oil pump and gearbox chip detectors for debris.	a. Debris found on chip detectors or rise in JOAP wear-metal readings noted.	a. Perform chip detector/JOAP analysis.
		b. No debris found on chip detectors.	b. Go to step 3.
3.	Perform engine rotation inspection. Check for unusual noises or binding.	a. Binding or unusual noises.	a. Teardown engine and repair module.
		b. No binding or unusual noises.	b. Go to step 4.
4.	If not done since engine assembly or last shop visit, perform complete engine borescope inspection. Also, inspect inlet and exhaust nozzle for damage.	a. Damage found.	a. Repair damage.
		b. No damage found.	b. Go to step 5.

CAUTION

For engine with vibration anomaly, perform rotation inspection before starting.

Step	Procedure	Result	Corrective Action
5.	Perform engine vibration analysis.	a. Vibration out of limits.	a. Replace module as identified in engine vibration analysis.
		b. Vibration within limits.	b. If vibration still exists, teardown engine to determine cause of vibration/ noise.
		c. No vibration.	c. Return engine to service.

SUBORDINATE WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE VIBRATION OUT OF LIMITS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE SWP PAGES

Total Number of Pages in this SWP is 10

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 10	21				

REFERENCE MATERIAL REQUIRED

Title	Number
Depot Engine Test	T.O. 2J-F100-11-2
Engine Acceptance Test	WP 212 00
Engine Vibration Analysis	WP 218 00
Oil System Contamination	WP 304 00
Depot Engine	T.O. 2J-F100-53-5
Receiving Inspection	WP 006 00
Borescope Inspection	WP 020 00
Nut, Compressor Disk and Hub; Housing, Counterweight; and Cover, Compressor Disk and Hub - Removal	WP 103 00
Nut, Compressor Disk and Hub; Housing, Counterweight; and Cover, Compressor Disk and Hub - Installation	WP 723 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This subordinate work package contains procedures for engine vibration out of limits (N1 and N2 components).

b. If vibration limit is exceeded at any power setting (steady state), source of unbalance shall be isolated and positive corrective action taken.

c. Excessive engine vibration requires inspection of tube and manifold assemblies.

2. GENERAL.

a. General vibration terms:

(1) The term E is used in engine vibration analysis and is equivalent to one excitation per revolution.

(2) The term 1E is commonly referred to as rotor passing frequency (rpm).

(3) Multiples of 1E can be used to identify other components driven by rotor, such as PTO shaft at 1.14EH.

(4) The term 1EH is equivalent to one excitation per revolution of high rotor (HPC and HPT).

(5) The term 1EF is equivalent to one excitation per revolution of low rotor (FAN and LPT).

b. Vibration limits in WP 218 00 covers both overall vibration limits and limits of high rotor (EH) and low rotor (EF). Overall limit applies to vibration level induced by both rotors and gearbox; EH and EF apply to individual rotor limits with one rotor vibration levels exceeding limits.

c. When an overall limit is exceeded, one of the rotor levels (EH or EF) or gearbox will make up the largest component (portion) of vibration level and will occur at frequency (EH, EF) of rotor responsible. Test stand vibration analyzer can identify vibration levels at 1EH, 1EF, and 1.14EH.

3. PRELIMINARY INSTRUCTIONS.

a. Review engine and module maintenance records (shop logs, AFTO Form 95 and AFTO Form 44). Consider engine or module condition (time/cycles) or recent significant maintenance action that may have induced rotor unbalance. High time modules within depot screen may be candidates for time or cycle change. It may not be practical to fault isolate the unbalance of high time assemblies.

b. Borescope or visually inspect modules, applying existing limits. Damaged rotating airfoils can contribute to rotor unbalance. Refer to T.O. 2J-F100-53-5, WP 001 00.

c. Engine JOAP records should be reviewed to determine if all elements are within wearmetal guidelines per WP 100 00 and WP 300 00.

d. Inspect oil pump and gearbox chip detectors per WP 304 00.

4. LOW ROTOR OUT OF LIMITS .

(See Table 1.)

a. Refer to table 1 for low rotor vibration out of limits (N1 component).

Table 1. Low Rotor Vibration Out Of Limits

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
1.	Check test stand vibration instruments for installation and accuracy.	a. Vibration instruments properly installed and reading accurate.	a. Go to step 2.
		b. Vibration instruments installed loosely; accelerometer or accelerometer cable causing inaccurate reading.	b. Install vibration instruments and/or cables correctly and repeat vibration analysis.
2.	Inspect gearbox and oil pump chip detectors per WP 304 00.	a. Chip detectors okay.	a. Go to step 3.
		b. Metal particles beyond T.O. limits present on chip detectors.	b. Isolate cause for chips and repair engine, as required.
3.	Review engine JOAP records.	a. JOAP within limits.	a. Go to step 4.
		b. Wearmetals exceed JOAP limits.	b. Isolate cause for wearmetal out of limits and repair engine, as required.
4.	Visually inspect fan and LPT for FOD.	a. No damage noted.	a. Go to step 5.
		b. Damage noted.	b. Repair, as required.
5.	Borescope inspect fan and LPT for damage. Refer to T.O. 2J-F100-53-5, WP 020 00.	a. No damage noted.	a. Go to step 6.
		b. Damage noted.	b. Repair as required.
6.	Inspect N1 Rotor for freedom of rotation. Refer to T.O. 2J-F100-53-5, WP 006 00.	a. Freedom of rotation check okay.	a. Go to step 7.
		b. Rubbing, scraping, or unusual noise present.	b. Isolate to fan or LPT, and repair as required.

Table 1. Low Rotor Vibration Out Of Limits (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
7.	Determine if engine has balance weights installed in fan counterweight housing.	a. No weights installed. b. Weights installed.	a. Go to step 12. b. Go to step 8.
8.	Review recent engine maintenance. Determine if weights were removed and reinstalled before last engine run.	a. Weights were removed and reinstalled. b. Weights were not removed.	a. Go to step 9. b. Go to step 11.
9.	Verify balance weights were installed correctly by ensuring indexing marks and weights are lined up correctly. Refer to T.O. 2J-F100-53-5, WP 103 00 and WP 723 00.	a. Weights were installed correctly. b. Weights were not installed correctly.	a. Go to step 11. b. Install weights correctly and go to step 10.
10.	Repeat engine vibration analysis test per WP 218 00.	a. Vibration out of limits. b. Vibration within limits.	a. Go to step 11. b. Return engine to service.
11.	Remove balance weights. Repeat vibration analysis test.	a. Vibration out of limits. b. Vibration within limits.	a. Go to step 12. b. Return engine to service.

Table 1. Low Rotor Vibration Out Of Limits (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
12.	Determine which vibration accelerometer is out of limits.	a. VICV or VGBV N1 component out of limits.	a. Go to step 13.
		b. VAP6 or VDCH N1 component out of limits.	b. Terminate test. Replace LPT.
13.	Determine which vibration analyzer was used to record vibration data.	a. PN VIC974FH	a. Go to step 14.
		b. Spectral Dynamics Model 4112, or Trigtek Model 623B	b. Go to step 15.

CAUTION

Operating engine over DO NOT EXCEED limits may result in engine damage.

NOTE

- VSEC = VICV N1 component at Intermediate (MIL) power in Secondary Control Mode
- VPRI = VICV N1 component at Intermediate (MIL) power in Primary Control Mode
- Reference DO NOT EXCEED limits per WP 218 00.
- If unable to calculate NLP due to DO NOT EXCEED limits, go to step 16.

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
14.	Calculate vibration Null Load Parameter (NLP) for PN VIC974FH vibration analyzer:		

$$NLP = \frac{(VSEC - VPRI) \text{ x } (VSEC + VPRI)}{2}$$

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
	Ensure NLP is calculated properly and order of subtraction is correct.	a. NLP greater than or equal to 3.0	a. Go to step 18.
		b. NLP less than 3.0	b. Go to step 16.

Table 1. Low Rotor Vibration Out Of Limits (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
15.	Calculate vibration Null Load Parameter (NLP) for Spectral Dynamics Model 4112, or Trigtek Model 623B vibration analyzer:		

$$\mathrm{NLP} = \frac{(\mathrm{VSEC} - \mathrm{VPRI})\ \mathrm{x}\ (\mathrm{VSEC} + \mathrm{VPRI})}{8}$$

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
	Ensure NLP is calculated properly and order of subtraction is correct.	a. NLP greater than or equal to 3.0	a. Go to step 18.
		b. NLP less than 3.0	b. Go to step 16.
16.	Disassemble engine and rotate fan 180 degrees relative to LPT shaft. Repeat engine acceptance test per WP 212 00.	a. Vibration out of limits.	a. Go to step 17.
		b. Vibration within limits.	b. Return engine to service.
17.	Review troubleshooting activity to determine if LPT module has been previously replaced during vibration troubleshooting recently conducted per step 18.	a. LPT module not previously replaced.	a. Go to step 18.
		b. LPT module replaced during current vibration troubleshooting.	b. Go to step 19.

Table 1. Low Rotor Vibration Out Of Limits (continued)

Step	Procedure	Normal Indication	Remedy for Abnormal Indication
18.	Disassemble engine and replace LPT. Repeat engine acceptance test per WP 212 00.	a. Vibration out of limits. b. Vibration within limits.	a. Go to step 19. b. Return engine to service.
19.	Review troubleshooting activity to determine if fan inlet module was previously rotated during current vibration troubleshooting per step 16.	a. Fan inlet module not previously rotated. b. Fan module rotated per step 16 during current vibration troubleshooting.	a. Go to step 16. b. Terminate test and replace fan module.

5. High Rotor Vibration Out Of Limits.
(See Table 2.)

a. Refer to table 2 for high rotor vibration out of limits (N2 component).

Table 2. High Rotor Vibration Out Of Limits

Step	Procedure	Result	Corrective Action
1.	Check test stand vibration instruments for proper installation and accuracy.	a. Vibration instruments properly installed and reading accurate.	a. Go to step 2.
		b. Vibration instruments installed loosely; accelerometer or accelerometer cable causing inaccurate reading.	b. Install vibration instruments and/or cables correctly and repeat vibration analysis.
2.	Inspect gearbox and oil pump chip detectors per WP 304 00.	a. Chip detectors okay.	a. Go to step 3.
		b. Metal particles beyond T.O. limits present on chip detectors.	b. Isolate cause for chips and repair engine, as required.
3.	Review engine JOAP records.	a. JOAP within limits.	a. Go to step 4.
		b. Wearmetals exceed JOAP limits.	b. Isolate cause for wearmetal out of limits and repair engine as required.
4.	Borescope inspect HPC and HPT for damage. Refer to T.O. 2J-F100-53-5, WP 020 00.	a. No damage noted.	a. Go to step 5.
		b. Damage noted.	b. Repair as required.
5.	Inspect N2 rotor for freedom of rotation. Refer to T.O. 2J-F100-53-5, WP 006 00.	a. Freedom of rotation check okay.	a. Go to step 6.
		b. Rubbing, scraping, or unusual noise present.	b. Isolate to HPC or HPT and repair as required.

Table 2. High Rotor Vibration Out Of Limits (continued)

Step	Procedure	Result	Corrective Action
6.	Disassemble engine and rotate HPT 180 degrees relative to HPC. Repeat engine acceptance test per WP 212 00.	a. Vibration out of limits.	a. Go to step 7.
		b. Vibration within limits.	b. Return engine to service.
7.	Determine which vibration accelerometer was out of limits.	a. VICV or VGBV N2 component out of limits.	a. Terminate test and replace core module.
		b. VAP6 or VDCH N2 component out of limits.	b. Terminate test and replace HPT module.

WORK PACKAGE

TECHNICAL PROCEDURES

OIL CONSUMPTION CHECK RUN

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 10

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	23	5	23	6 - 10	0
2 - 4	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Depreserving	WP 108 00
Engine Oil System Servicing	WP 109 00
Engine Motoring	WP 110 00
Engine Operating Limits	WP 205 00
Engine Start Procedures	WP 210 00
Engine Shutdown	WP 225 00
Oil Smoke Emitting from Exhaust Nozzle or High Oil Consumption	WP 532 00
Engine	T.O. 2J-F100-53-5
Fan Drive Turbine Module and Rear Compressor Drive Turbine Assembly - Inspection	WP 414 00
Bearing Compartment, No. 2, No. 3 and No. 4 and Gearbox Module - Vacuum Leak Check	WP 433 00
Compartment, No. 1 Bearing - Vacuum Leak Check	WP 434 00
Compartment, No. 5 Bearing - Vacuum Leak Check	WP 439 00
Inspection Following Removal of Rear Compressor Drive Turbine Rotor and Stator Assembly	WP 445 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

Nomenclature	Part Number	Quantity
Oil, lubricating	MIL-L-7808	As required

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains an engine oil consumption check run.

2. OIL CONSUMPTION CHECK RUN.

(See Figures 1 through 3.)

CAUTION

Take oil level reading from engine oil tank sight gage scale (graduated in half pints) within 15 minutes of engine shutdown during oil consumption check run to ensure oil is hot. Strict adherence to 15 minute time limitation is important to accuracy of oil consumption measurement because of effects of thermal expansion on oil quantity.

NOTE

Determine oil quantity in engine and oil quantities added and consumed to nearest half pint.

a. If engine has been shutdown for more than 15 minutes, perform prerun oil servicing as follows: (See figure 1.)

(1) Fill engine oil tank to overflow level. Refer to WP 109 00.

(2) Motor engine for a minimum of 15 seconds. Refer to WP 110 00.

(3) Drain or fill oil tank to bring oil level to color break line, but no greater than a 1/4 inch above color break line.

(4) Start engine per procedures in WP 210 00.

(5) Stabilize at IDLE for ten minutes.

NOTE

Oil foam caused by contamination has been known to appear as many small bubbles filling sight gage and settling out after approximately one minute.

(6) Shut down engine per procedures contained in WP 225 00. Immediately after shutdown, check oil tank sight glass for oil foaming.

(7) If foam is evident, flush oil system using procedures in WP 108 00.

(8) If oil level is below sight gage, reject engine for oil consumption.

CAUTION

Engine hot oil servicing should be done within 15 minutes after shut down (performed in step 6) to ensure accuracy of measurement.

(9) Perform hot oil servicing as follows:

(a) Connect oil tank fill and drain lines. Refer to WP 109 00.

(b) Drain oil from drain line.

NOTE

Be careful not to over fill the tank. Servicing cart should be pumped slowly and its oil lines should remain connected until all oil flow has visibly stopped in the cart sight glass.

(c) Add oil at fill line until oil is observed coming out of drain line.

(d) Carefully read oil level from oil tank sight gage scale to the nearest half pint.

b. If engine has been shut down less than 15 minutes and oil is visible in sight glass, then service to overflow and record oil level from oil tank sight gage scale (in half pints). If oil level is below sight glass, then oil consumption is excessive, and prior to further engine running, perform the following:

(1) Inspect engine for location of oil leakage.

(2) Vacuum check bearing compartments. Refer to T.O. 2J-F100-53-5, WPs 434 00, 439 00 and 433 00.

CAUTION

If a large amount of oil is needed to refill the engine, careful reinspection per oil consumption troubleshooting procedures should be accomplished prior to further engine running. During engine running oil pressure and engine exhaust should be watched carefully during entire run. Any signs of excessive oil pressure fluctuation or drop, or exhaust smoke, especially on power decel, should be cause for immediate engine shutdown for oil level check. Continued operation under these conditions can result in severe engine damage from possible internal oil fire.

(3) Fill oil tank to bring oil level to color break line, but no greater than a 1/4 inch above color break line.

CAUTION

Observe engine operating limits in WP 205 00, throughout oil consumption run. If at any time during this run, heavy oil smoke is being continuously emitted from engine exhaust, discontinue testing and refer to WP 532 00 for corrective action. Failure to adhere to these limits can result in engine damage.

c. Perform oil consumption run as follows:

(1) Start engine per procedures in WP 210 00.

(2) Stabilize at PRIMARY mode IDLE and remain at this speed for 30 minutes.

(3) Shut down engine per procedures contained in WP 225 00; then perform following step d. within 15 minutes of engine shutdown.

d. Perform post-run servicing and oil consumption check within 15 minutes after engine shutdown as follows:

(1) Carefully read oil tank level from oil tank sight gage scale to the nearest half pint.

(2) Determine the amount of oil consumed during the oil consumption run by subtracting the oil level reading after shutdown from the level prior to start. Divide this quantity by the length of the run in hours. If this rate exceeds the oil consumption limit of one pint per hour (See figure 2.), perform corrective action per WP 532 00.

(3) If oil consumption limit is not exceeded, an attempt may be made to duplicate oil consumption experienced operationally at higher power settings. Repeat procedure at applicable power setting, if desired.

(4) If oil consumption limit is not exceeded but excess smoke or other symptoms persist, perform the following test:

(a) Start engine per procedures in WP 210 00.

(b) Advance power lever to obtain an N2 speed of 11,500 rpm. Stabilize two minutes.

(c) Record Pscv-4 and engine burner pressure (Pb). Plot values on figure 3.

(d) If data point is not in acceptable region of figure 3, discontinue testing and perform No. 4 bearing teardown inspection. Inspect rear compressor drive turbine assembly per T.O. 2J-F100-53-5, WP 445 00 and fan drive turbine module per T.O. 2J-F100-53-5, WP 414 00. If data point is within acceptable region repeat steps(4) (b) and (c) except at an N2 speed of 12,500 rpm. Proceed to next step.

(e) If data points at 12,000 and 12,500 N2 rpm are not in acceptable region of figure 3, discontinue testing and perform No. 4 bearing teardown inspection. Inspect rear compressor drive turbine assembly per T.O. 2J-F100-53-5, WP 445 00 and fan drive turbine module per T.O. 2J-F100-53-5, WP 414 00. If data points are within acceptable region, proceed to next step.

(f) Accelerate to Intermediate (MIL). Stabilize two minutes.

CAUTION

Maximum No. 4 bearing oil scavenge pressure shall not exceed 63 psia.

(g) Record No. 4 bearing scavenge pressure (Pscv-4)

NOTE

Occasional or intermittent puffs of smoke during rapid acceleration or deceleration are not cause for concern.

(h) Perform a rapid deceleration to IDLE. Observe engine exhaust for heavy smoke. If prolonged smoke is observed, discontinue testing and perform No. 4 bearing teardown inspection. Inspect rear compressor drive turbine assembly per T.O. 2J-F100-53-5, WP 445 00 and fan drive turbine module per T.O. 2J-F100-53-5, WP 414 00. If smoke level is acceptable, proceed to next step.

(i) Stabilize at Idle for two minutes.

(j) Perform a rapid acceleration to Intermediate (MIL). Stabilize two minutes.

(k) Record Pscv-4.

(l) Decelerate to IDLE and observe exhause for smoke.

(m) Repeat steps(4) (i) through (l) four additional times, then proceed to next step.

(n) Calculate the average Pscv-4 for the five recorded values. Pscv-4 must not exceed 50 psia. If Pscv-4 value is greater than 50 psia, discontinue testing and perform No. 4 bearing teardown inspection. Inspect rear compressor drive turbine assembly per T.O. 2J-F100-53-5, WP 445 00 and fan drive turbine module per T.O. 2J-F100-53-5, WP 414 00. If Pscv-4 value is less than 50 psia and excessive smoke is not observed, suspect compartments other than No. 4 bearing.

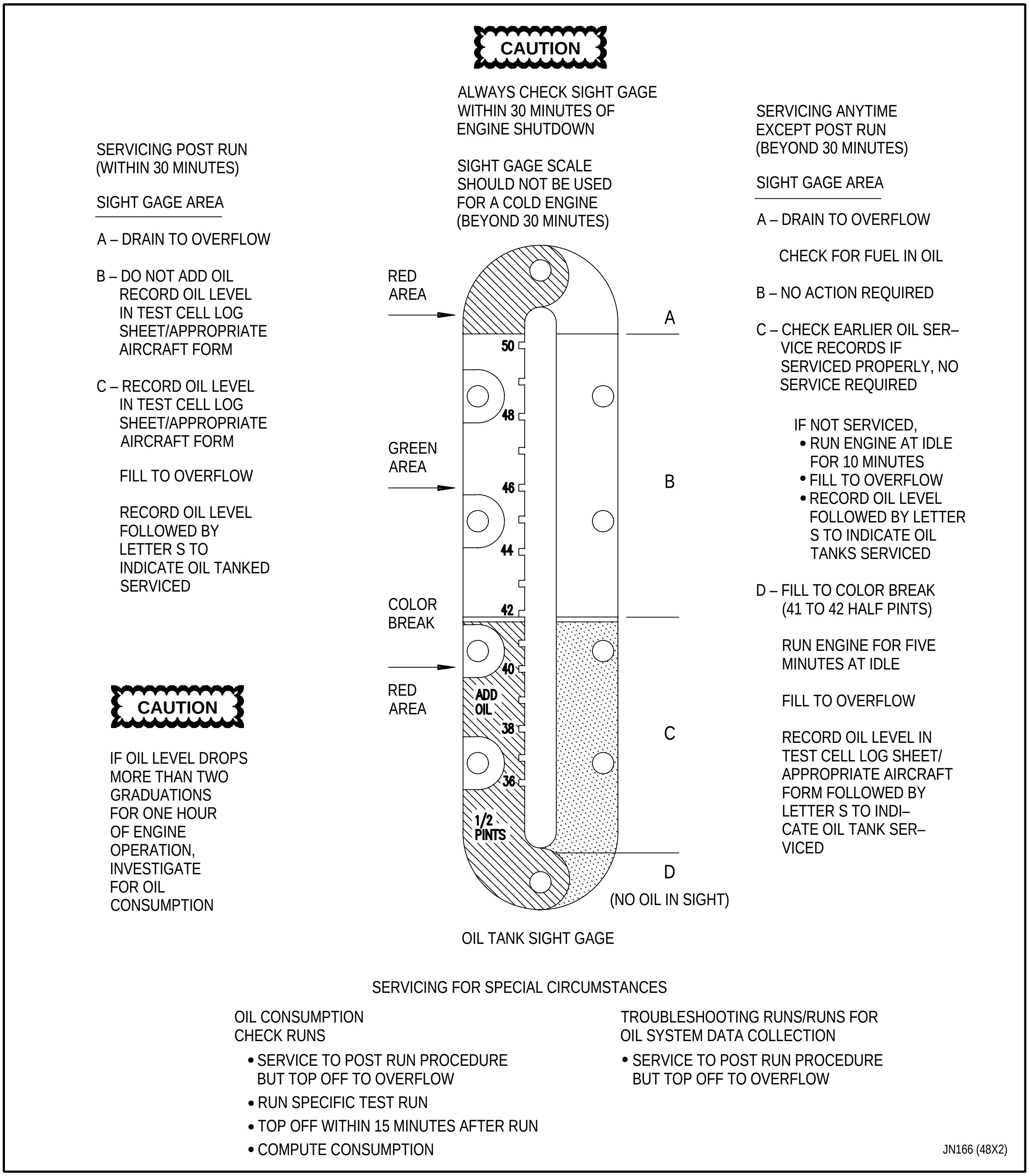


Figure 1. Oil Servicing - Requirements

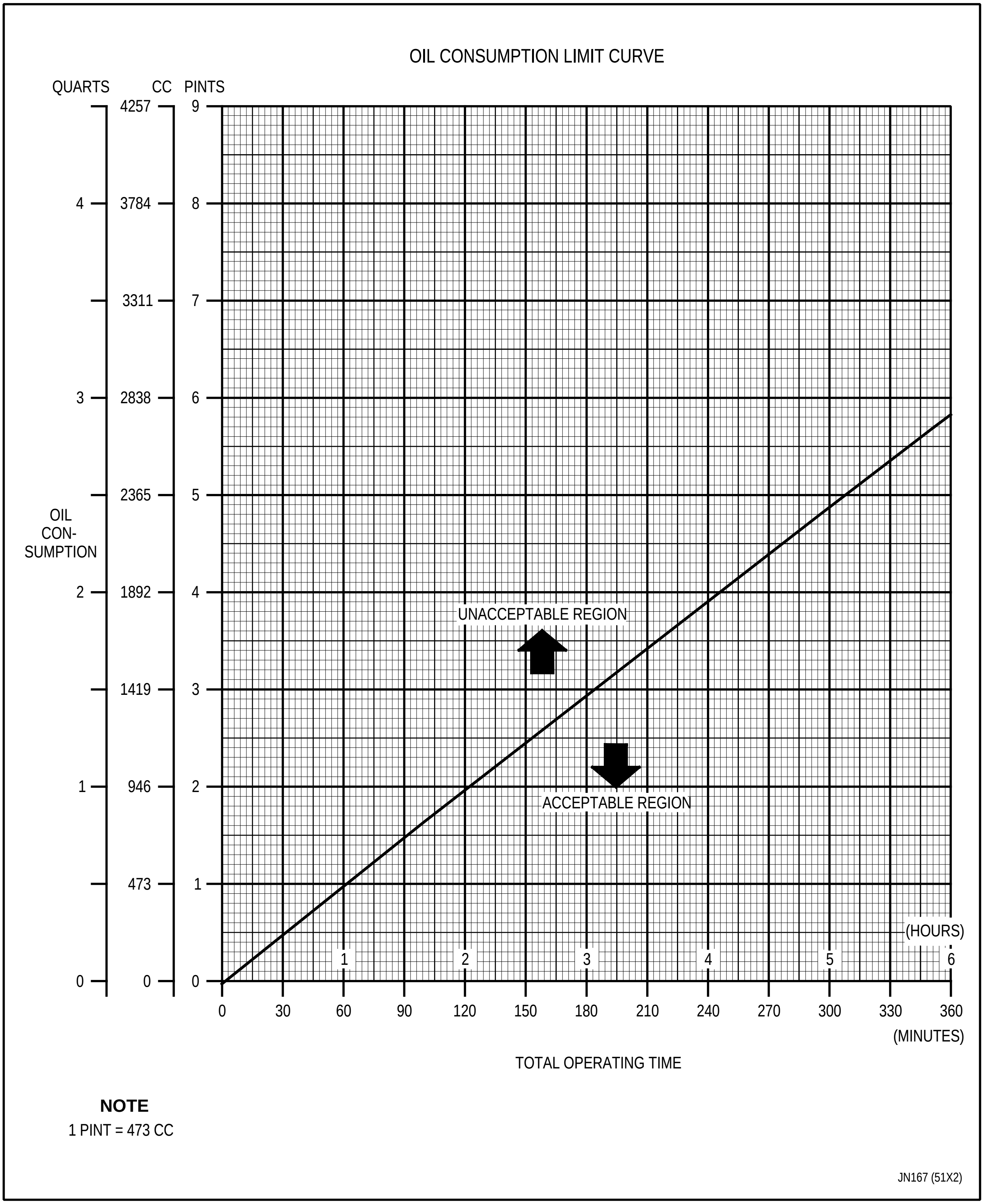


Figure 2. Oil Consumption Limit Curve

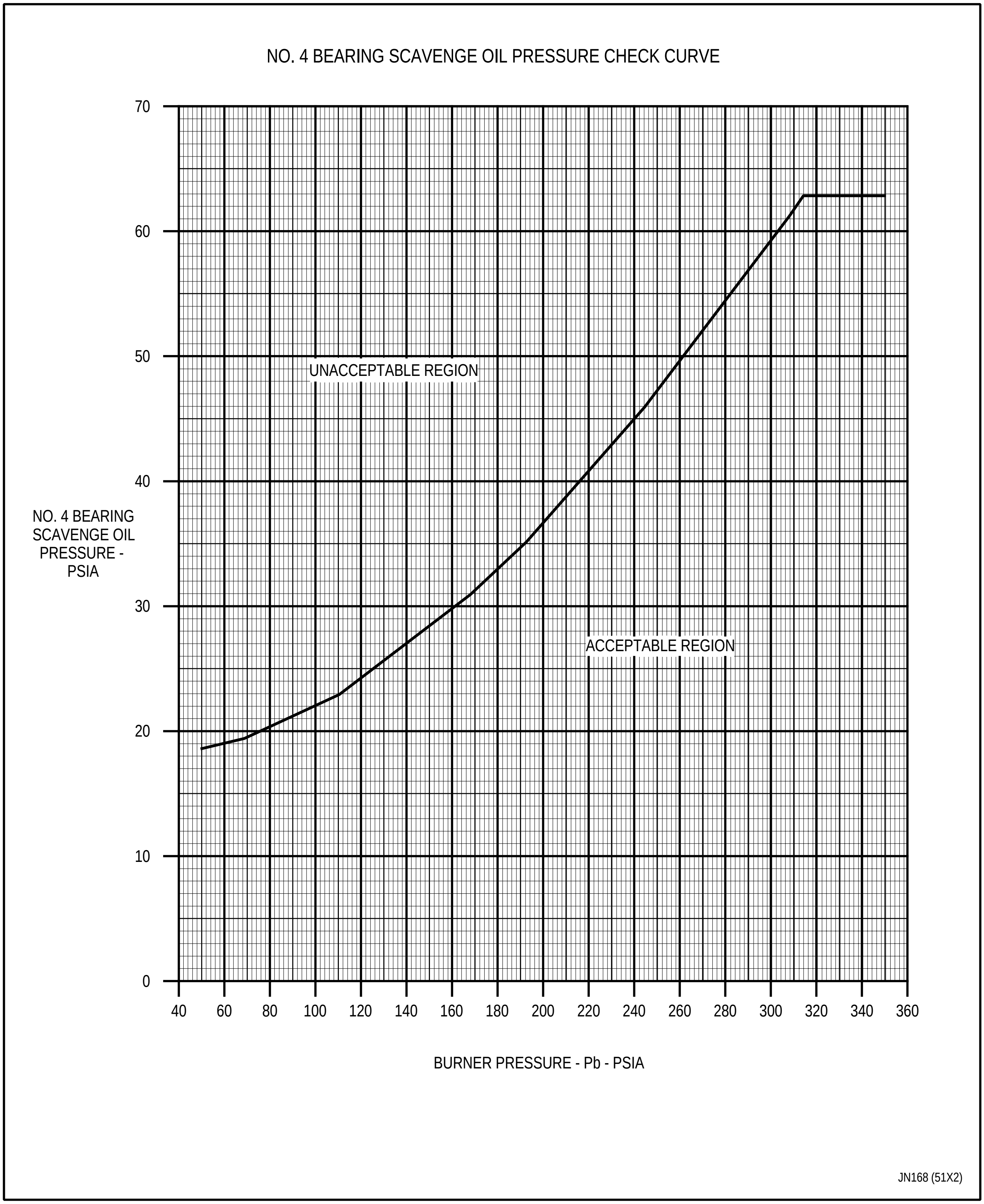


Figure 3. No. 4 Bearing Scavenge Oil Pressure Check Curve

WORK PACKAGE

TECHNICAL PROCEDURES

OIL CONTAMINATION CHECK RUN

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Standard Maintenance Procedures	T.O. 2-1-111
Engine Test	T.O. 2J-F100-11-2
Engine Motoring	WP 110 00
Engine Start Procedures	WP 210 00
Engine Shutdown	WP 225 00
Joint Oil Analysis Program (JOAP) Wearmetal Guidelines	WP 303 00
Oil System Contamination	WP 304 00
On Condition Maintenance Manual	T.O. 2J-F100-53-2
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Filter - Oil	WP 030 00
Detector - Metal Chip, Oil Sump	WP 033 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

Nomenclature	Part Number	Quantity
Oil, lubricating	MIL-L-7808	As required

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains engine oil system contamination check run procedures.

2. OIL SYSTEM CONTAMINATION.

CAUTION

A collapsed oil filter will allow contamination to reach all bearing compartments and is cause for engine teardown to extent necessary to completely review all oil system hardware.

NOTE

- During removal of the oil filter assembly in the following procedures, take precautions to drain oil through fine filter paper to prevent loss of foreign particles that might otherwise go unnoticed. If foreign particles are present, collect available particles as samples for analysis. Collect fine particles by sloshing filter element in cleaning solvent while filter element is contained in clean cloth. Clean chip detectors. Refer to T.O. 2J-F100-53-4, WP 033 00.
- When engine is forwarded for disassembly, also forward any foreign particles from oil filter or chip detectors in clear plastic envelope.
- The magnetic feature of chip detectors can accumulate debris and even small ferrous items, such as nuts, lockwire or other shop debris. Ensure that detectors are clean before installation into engine.

a. Presence of material in any form other than ingredients that make up engine oil is considered foreign material. Metal, rubber particles, dirt, carbon, lint, etc., are some foreign particles that contribute to oil contamination. These particles can cause oil leaks, part scoring, and oil strainer and jet clogging which, if not detected promptly, can result in oil starvation and bearing failure. It is difficult to provide specific limits regarding size, weight, composition, and number of particles accumulating on main oil filter or chip detectors for continued engine operation.

b. When foreign material in oil filter or chip detectors is identified as nonengine-generated, such as machining chips, lockwire, and steel shot perform an oil contamination check run.

c. If engine is returned to service after oil contamination check run, place engine under surveillance for 10 hours per step e.(5).

d. When foreign material in oil filter or on chip detectors is identified as engine-generated, such as chips from spalling, disassemble engine to determine source of chips.

e. Contamination check run.

(1) Clean all chip detectors, oil filter, and oil filter bowl. Refer to T.O. 2J-F100-53-4, WP 030 00 and 033 00.

CAUTION

Do not shut down engine with main fuel switch/handle except for an emergency. Use of main fuel switch/handle may cause main fuel pump cavitation and possible pump damage.

(2) Start engine and operate at Idle for 30 minutes, then shut down engine. Refer to WP 210 00 and 225 00.

(3) Take JOAP sample from oil tank JOAP valve.

(4) Check chip detectors. Refer to WP 304 00.

(5) Remove and inspect chip detectors, oil filter, and bottom of oil filter bowl for cleanness. Refer to T.O. 2J-F100-53-4, WP 030 00 and 033 00. If oil filter, oil filter bowl, and chip detectors are clean and JOAP results are normal, engine may be returned to service but shall be monitored as follows:

(a) Inspect chip detectors at intervals, not to exceed 3 hours total operating time until these checks, during a 10 hour period indicate no cause for concern.

(b) Monitor engine under JOAP surveillance restrictions. Refer to WP 303 00. Notify JOAP lab. If no other cause for JOAP surveillance exists after 10 hours total operating time, remove engine from surveillance and revert to normal sampling.

(c) JOAP lab personnel are to be informed of all contamination findings.

f. If large pieces of metal are found in main oil filter, definitely identified as foreign to internal parts of engine and which had entered engine through oil tank filler opening, removal, disassembly, and inspection of main oil pump is necessary. Damage to oil pump will require replacement of pump but no further disassembly of engine.

g. If filter continues to be contaminated, engine should be disassembled to determine possible source of failure causing release of particles.

h. Extreme amount of sludge or carbon particles in oil filter can be detrimental as this could indicate breakdown of oil and reduction of oil flow due to clogging of bearing jets.

i. Particles of metal found in engine may be of granular and/or flake form. Granular particles are defined as grain-like particles which have appearance of having been removed by grinding process. It is possible that some granular particles will appear in flake form as a result of having passed through gears; however, it is not likely that all granules generated will be subjected to rolling process; therefore, they can be readily identified by close visual inspection. Metal flakes are defined as small flat pieces of metal appearing as flimsy masses or scale-like particles.

j. For identification of metal particles, refer to T.O. 2-1-111.

k. Contamination (nonmetallic).

(1) If, upon analysis, foreign particles are found to be other than metal (carbon, dirt, sludge, or bits of rubber) oil shall be drained. Remove oil tank, fuel oil cooler, and affected lines, and clean system. When bits of rubber are found in oil system, system shall be checked for possible seal extrusion. After system has been cleaned, new oil seals shall be used where seals were disturbed, and oil system components shall be reinstalled.

(2) When servicing engine oil system, or at any time oil contamination with fuel is suspected, oil contamination rate shall be checked. When no oil consumption or tank oil level increase is noted, fuel contamination may be result of internal fuel to oil leakage in fuel oil cooler or failed main fuel pump driveshaft seal.

l. Establish percentage of oil contamination by laboratory analysis of oil samples. Refer to WP 304 00.

CAUTION

Do not shut down engine with main fuel switch/handle except for an emergency. Use of main fuel switch/handle may cause main fuel pump cavitation and possible pump damage.

(1) Start engine and operate at Idle for 10 minutes; then shut engine down per WP 210 00 and 225 00.

(2) Remove and inspect chip detectors for contamination.

(a) If chips are found on chip detectors, identify chips per WP 304 00.

(b) If chips are identified as nonengine-generated chips or as engine-generated spalling chips, disassemble engine to determine source of chips.

(3) If chip detector check is acceptable, proceed as follows:

(a) Start engine and stabilize at Idle per WP 210 00.

(b) Gradually advance power lever to Intermediate (MIL). Run engine intermediate for 15 minutes.

(c) Move power lever to IDLE. Stabilize for 5 minutes; then shut down engine per WP 225 00.

(d) Recheck chip detectors for contamination.

(e) Take JOAP sample and repeat contamination check per step l.

(4) It may be necessary to repeat oil draining, refilling and engine running procedure more than once to remove all residual contaminated oil in engine.

(5) When specific gravity check indicates that oil is not contaminated, engine may be continued in service.

WORK PACKAGE

TECHNICAL PROCEDURES

Tt2 SYSTEM OUT OF LIMITS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	21				
6 Blank	21				

REFERENCE MATERIAL REQUIRED

Title	Number
Depot Engine Test	T.O. 2J-F100-11-2
Idle Functional Check	WP 216 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Tt2A AND Tt2B SIGNALS DIFFER	
	OHMMETER	PSM-6 OR EQUIVALENT

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for Tt2 system out of limits.

2. Tt2A AND Tt2B SIGNALS DIFFER.

(See Figure 1 and Table 1.)

a. Cause of Anomaly:

(1) Tt2A minus Tt2B not between -3°C to +3°C (-5.4 to +5.4°F).

b. Engine Symptoms:

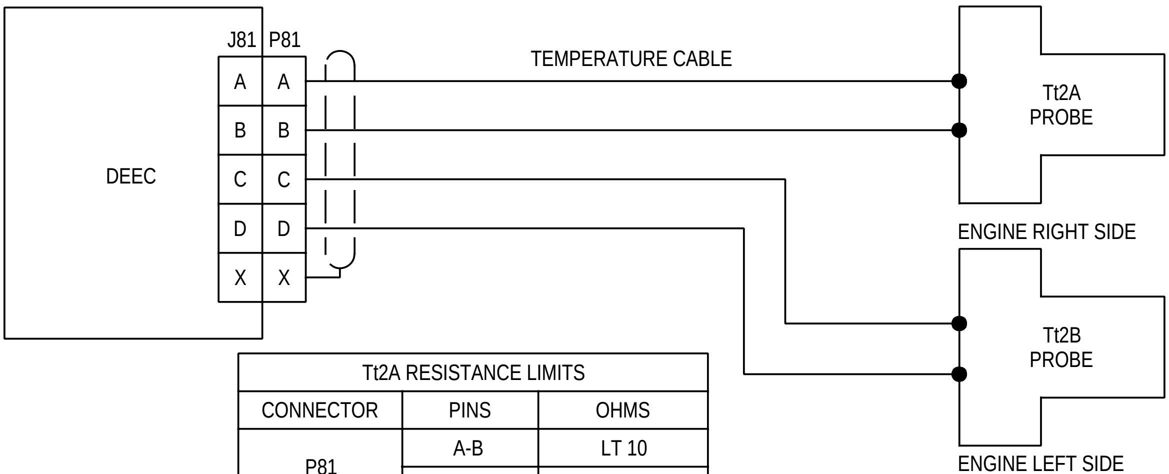
(1) None.

c. Test Cell Observations:

(1) None.

Table 1. Tt2A and Tt2B Signals Differ

Step	Procedure	Result	Corrective Action
1.	Visually inspect Tt2 probe for damage.	a. No damage.	a. Go to step 2.
		b. Probe damaged.	b. Replace Tt2 probe. Go to step 3.
2.	Perform following resistance checks (See figure 1):		
	a. CONN P81 PINS 1. A to X 2. C to X	a.1. Resistance checks within limits: 1. GT 50,000 OHMS 2. GT 50,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace DEEC temperature cable.
	b. CONN P81 PINS (Tt2A) 1. A to B 2. A to GND (Tt2B) 3. C to D 4. C to GND	b.1 Resistance checks within limits: 1. LT 10 OHMS 2. GT 50,000 OHMS 3. LT 10 OHMS 4. GT 50,000 OHMS	b.1. Go to step 3.
		b.2. Resistance checks out of limits.	b.2. Replace DEEC temperature cable.
3.	Perform IDLE functional check per WP 216 00.	a. Tt2A (EMSE/DEEC) minus Tt2B (EMSE/DEEC) between -3°C to +3°C (-5.4 to +5.4°F).	a. Return engine to service.
		b. Tt2A (EMSE/DEEC) minus Tt2B (EMSE/DEEC) out of limits.	b. Replace DEEC temperature cable and repeat steps 2 and 3.



Tt2A RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P81	A-B	LT 10
	A-GND	GT 50,000
	A-X	GT 50,000

Tt2B RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P81	C-D	LT 10
	C-GND	GT 50,000
	C-X	GT 50,000

JN96X1 (37X2)

Figure 1. Tt2 Temperature Probe Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

Ps2 SYSTEM (PRIMARY MODE) OUT OF LIMITS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	21				
6 Blank	21				

REFERENCE MATERIAL REQUIRED

Title	Number
Depot Engine Test	T.O. 2J-F100-11-2
DEEC Pressure Sensing System Analysis	WP 675 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for Ps2 system (PRIMARY mode) out of limits.

2. Ps2 PRESSURE SYSTEM MALFUNCTION.

(See Figure 1 and Table 1.)

a. Cause of Anomaly:

(1) Ps2 (bellmouth) minus Ps2 (DEEC) not between 0.0 to 0.5 in. Hg.

b. Engine Symptoms:

(1) None.

c. Test Stand Observations:

(1) None.

Table 1. Ps2 Pressure System Malfunction

Step	Procedure	Result	Corrective Action
1.	Determine if Ps2 (bellmouth) is greater than Ps2 (DEEC).	a. Ps2 (bellmouth) minus Ps2 (DEEC) greater than 0.5 in. Hg.	a. Troubleshoot Ps2 (bellmouth). Refer to test stand troubleshooting procedures.
		b. Ps2 (bellmouth) minus Ps2 (DEEC) less than 0.0 in. Hg.	b. Troubleshoot Ps2 (DEEC). Go to step 2.
2.	Perform DEEC pressure sensing system analysis per WP 675 00.	a. Analysis passed.	a. Return engine to service.
		b. Analysis noted problem.	b. Go to step 3.
3.	Remove Ps2 line from DEEC and inspect transducer port for fluid contamination.	a. No fluid was seen in Ps2 transducer port.	a. Continue to step 4.
		b. Fluid was seen in Ps2 transducer port.	b. Remove and replace DEEC.
4.	Inspect DEEC Ps2 sense line for leaks, loose fittings, chafing, and blockage per figure 1.	a. No plumbing problems noted.	a. Continue to step 5.
		b. Plumbing problems noted.	b. Repair plumbing as required.

Table 1. Ps2 Pressure System Malfunction (continued)

Step	Procedure	Result	Corrective Action
5.	Start engine and stabilize at IDLE for 5 minutes. Snap throttle to Intermediate (MIL) and stabilize 3 minutes. Compare bellmouth and DEEC Ps2 values. Retard throttle to IDLE and stabilize 5 minutes. Shut down engine when test is finished.	a. Bellmouth and DEEC Ps2 values within limits (0.0 to 0.5 in. Hg). b. Ps2 values out of limits.	a. Return engine to service. b.1. Check Ps2 sense line plumbing for leaks per figure 1. b.2. If problem still exists, perform Ps2 vacuum and airflow check. Repair Ps2 system as required. Go to step 6.
6.	If anomaly repeats, replace components in the following order (if component has not been previously changed), until engine operates properly: • DEEC • Ps2 sense line plumbing • Ps2 probe • Inlet Case	a. Ps2 (bellmouth) minus Ps2 (DEEC) between 0.0 to 0.5 in. Hg. b. Ps2 (bellmouth) minus Ps2 (DEEC) outside 0.0 to 0.5 in. Hg range.	a. Return engine to service. b. Replace next component. Repeat steps 5 and 6.

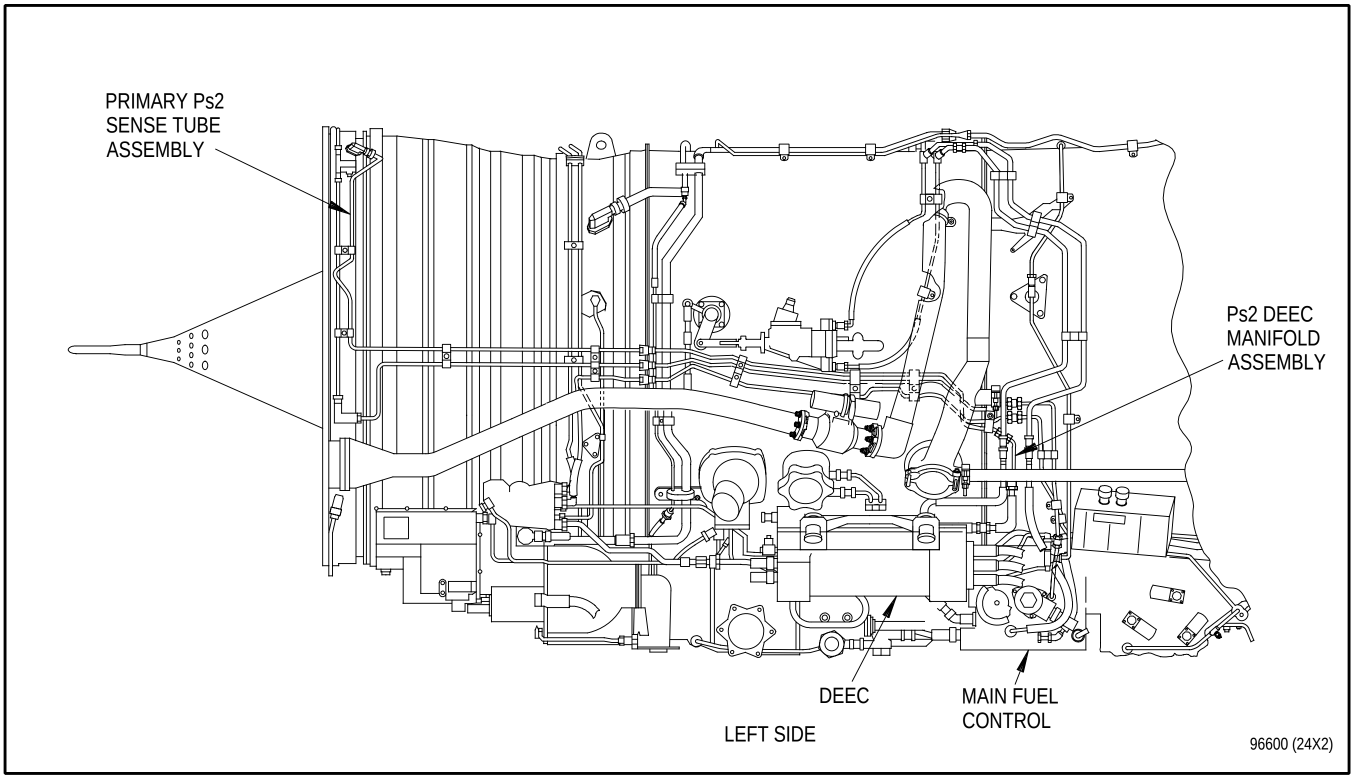


Figure 1. DEEC Ps2 Sense Line Inspection

WORK PACKAGE

TECHNICAL PROCEDURES

EDU PEACE TIME THRUST (PTT) CLOCK TIME ADVANCES

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	23				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
IDLE Functional Check	WP 216 00
Engine Shutdown	WP 225 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	EDU PTT CLOCK TIME ADVANCES	
	VOLT/OHMMETER	PSM-6 OR EQUIVALENT

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting instructions for EDU Peace Time Thrust (PTT) clock time advancing.

2. EDU PTT CLOCK TIME ADVANCES.

(See Figure 1 and Table 1.)

NOTE

F-15I aircraft are equipped with a cockpit switch to operate in reduced airflow mode. The EDU Peace Time Thrust (PTT) clock counter increases to record hours of operation in reduced airflow mode. If PTT increases on engines installed in aircraft or test cells equipped with a reduced airflow mode switch, troubleshooting per this work package is not required.

a. Cause of PTT increasing.

(1) Test stand wiring, power and speed cable, DEEC.

b. Engine Symptoms.

(1) None.

c. Test Stand Observations.

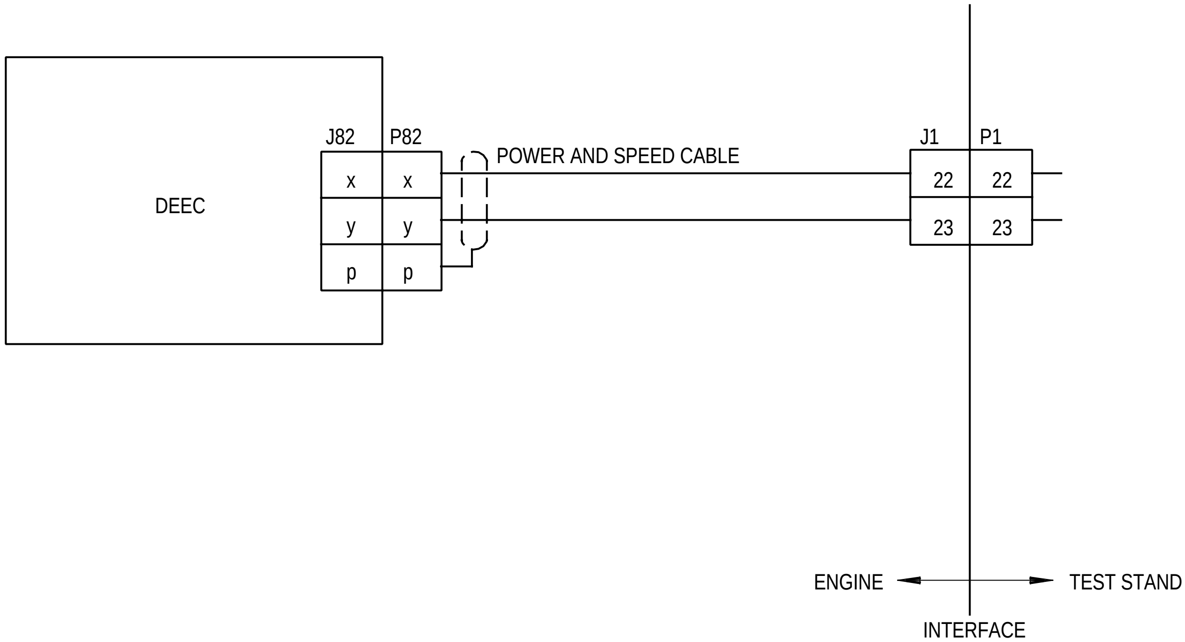
(1) None.

Table 1. EDU PTT Clock Time Advances

Step	Procedure	Result	Corrective Action
1.	Review fault and event data per WP 180 00.	a. Other DEEC/EDU faults present.	a. Troubleshoot DEEC/EDU faults, then go to step 2.
		b. Other events present.	b. Troubleshoot events, then go to step 2.
		c. No faults or events are present.	c. Go to step 2.
2.	Disconnect P82 from DEEC. Perform the following resistance checks. (See figure 1.)		
	a. CONN P82 PINS	a.1. Resistance checks within limits:	a.1. Go to step 4.
	1. x to y	1. GT 100,000 OHMS	
	2. x to GND	2. GT 100,000 OHMS	
	3. y to GND	3. GT 100,000 OHMS	
	4. x to p	4. GT 100,000 OHMS	
	5. y to p	5. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Go to step 3.
3.	Disconnect P1 connector. Perform the following resistance checks. (See figure 1.)		
	a. CONN P82 PINS	a.1. Resistance checks within limits:	a.1. Troubleshoot test stand wiring.
	1. x to y	1. GT 100,000 OHMS	
	2. x to GND	2. GT 100,000 OHMS	
	3. y to GND	3. GT 100,000 OHMS	
	4. x to p	4. GT 100,000 OHMS	
	5. y to p	5. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable.

Table 1. EDU PTT Clock Time Advances (continued)

Step	Procedure	Result	Corrective Action
4.	Connect connectors P1 and P82. Perform IDLE functional check per WP 216 00. Operate engine for a minimum of 12 minutes. Perform engine shutdown per WP 225 00 and verify EDU PTT clock time does not advance.	a. PTT clock time does not advance.	a. Return to service.
		b. PTT clock time advances.	b. Replace following components until PTT stops advancing. • DEEC • Power and speed cable



DEEC REDUCED AIRFLOW MODE RESISTANCE LIMITS		
PINS (P82)	PINS (P1)	OHMS
x–y	22–23	GT 100,000
x–GND	22–GND	GT 100,000
y–GND	23–GND	GT 100,000
x–p		GT 100,000
y–p		GT 100,000

97681 (36X2)

Figure 1. Reduced Airflow Mode Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1000:
NON-RECOVERABLE STALL - IDLE AND ABOVE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Mode Select Malfunction	WP 522 00
Secondary Mode Anomaly	WP 523 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00
Augmentor Duct and Nozzle Module Duct	T.O. 2J-F100-53-10
Duct, Augmentor Combustion Chamber Inspection	WP 328 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for non-recoverable stall at IDLE and above.

2. EDU EVENT CODE 1000: NON-RECOVERABLE STALL - IDLE AND ABOVE

(See Table 1.)

NOTE

Event Code 1000 will not be recorded by EMS for engines being tested for the F15 configuration, if one of the following conditions is satisfied:

- IAR on PLA at IDLE, and Mn less than 0.2 (octal less than 286).
- Aircraft tail number set to zeros (00-0000), PLA at IDLE, and Mn less than 0.2 (octal less than 286).

a. Cause of Event:

(1) Non-recoverable stall detected: DEEC flag turned on when N2/FTIT less than 5.6 rpm/degrees F or P_b/P_{t2c}, which is a function of N_2C_2. EDU monitors DEEC UART for this flag.

(2) Severe stalls.

(3) Engine shut down using fire button.

(4) Fuel delivery interruption.

b. Engine Symptoms:

(1) Engine N2 rotor speed decreasing with corresponding FTIT increase. Engine has to be shut down and then restarted to clear stall.

c. Data Recorded by EDU:

- Altitude
- Mach number
- PLA
- PLA rate
- Ps2
- Tt2
- Aircraft angle of attack
- Aircraft angle of yaw
- Control mode
- Time of occurrence
- Anti-ice on or off
- Maximum FTIT

Table 1. EDU Event Code 1000: Non-Recoverable Stall - IDLE and Above

Step	Procedure	Result	Corrective Action
1.	Determine if fuel supply was interrupted or cut off during event.	a. Fuel flow not interrupted or cut off.	a. Go to step 2.
		b. Fuel flow interrupted or cut off.	b. Troubleshoot test cell fuel delivery system. Return engine to service.
2.	Perform complete inlet, exhaust, and borescope inspection.	a. Inspection within limits.	a. Annotate AFTO 95 and go to step 3.
		b. Inspection not within limits.	b. Annotate AFTO 95 and reject for repair.
3.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No additional events or faults present.	b. Troubleshoot stall anomaly.

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1020:
ENGINE STALL - IDLE AND ABOVE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00
Engine Acceptance Test	WP 212 00
Acceleration/Deceleration Checks	WP 213 00
Augmentor Fuel System Analysis	WP 662 00
DEEC Pressure Sensing System Analysis	WP 675 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Cylinders - Actuating, Linear, Variable Vane, Rear Compressor - Rigging	WP 101 00
Rear Compressor Variable Vane Internal Rigging Check	WP 104 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00
Inlet/Fan Module	T.O. 2J-F100-53-6
Compressor Inlet Variable Vane (CIVV) Cylinder System - Rigging	WP 705 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Logic (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

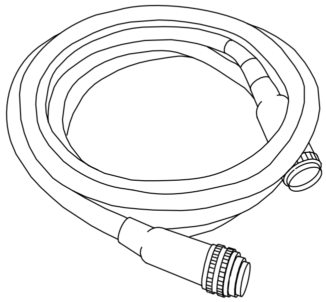
EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

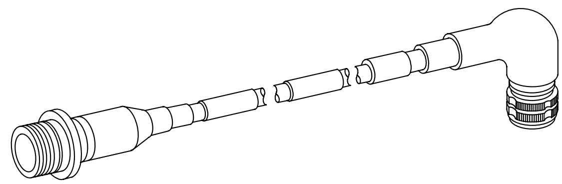
Paragraph	Function - Tool Nomenclature	Tool Number
2	EDU EVENT CODE 1020: ENGINE STALL - IDLE AND ABOVE	
	INTERFACE CABLES	PWA 56032 OR
	SYSTEM, INTERFACE ASSY, EAU, INTERMEDIATE	PWA 56033
	ENGINE ANALYZER UNIT	PWA 56084
	CEDS SOFTWARE	PWA 56091
	TRANSFER UNIT	PWA 56102
	CEDS INTERFACE ASSEMBLY	PWA 56114

ILLUSTRATED SUPPORT EQUIPMENT



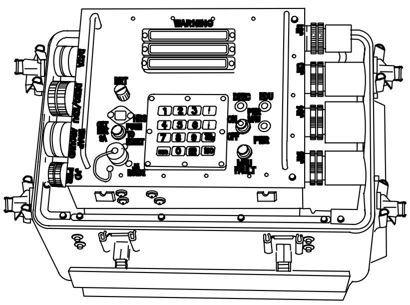
PWA 56032 –C

Figure T1. PWA 56032 INTERFACE CABLE



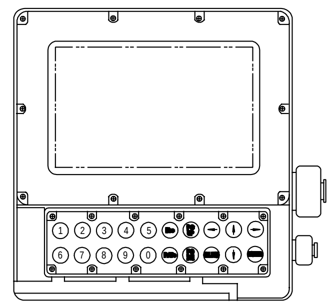
PWA 56033 –C

Figure T2. PWA 56033 SYSTEM INTERFACE ASSEMBLY



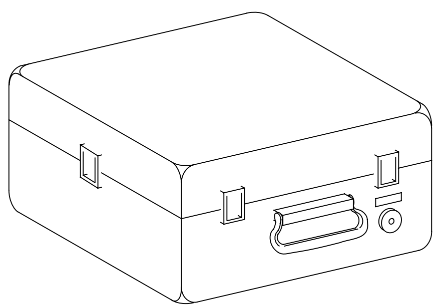
PWA 56084 –C

Figure T3. PWA 56084 ENGINE ANALYZER UNIT



PWA 56102 –C

Figure T4. PWA 56102 TRANSFER UNIT



PWA 56114 –C

Figure T5. PWA 56114 CEDS INTERFACE ASSEMBLY

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for engine stall, IDLE and above.

2. EDU EVENT CODE 1020: ENGINE STALL - IDLE AND ABOVE.

(See Figure 1 and Table 1.)

NOTE

Event Code 1020 will not be recorded by EDU for engines being tested for F15 configuration, if one of the following conditions is satisfied:

- IAR ON, PLA at IDLE, and Mn less than 0.2 (octal less than 286).
- Aircraft tail number set to zeros (00-0000), PLA at IDLE, and Mn less than 0.2 (octal less than 286).

a. Cause of Event:

(1) An airflow anomaly in the compressor. In augmentation, an augmentor blowout or mislight is usually the cause. Between Idle and Intermediate (MIL) power, RCVV or fuel flow misscheduling or compressor deterioration is usually the cause. DEEC flag is turned on when Pb rate of change/Pb is less than -4.0 psia/sec/psia. The EDU monitors DEEC UART for this flag.

(2) Engine shutdown using fuel shut-off valve.

(3) Fuel system delivery interruption.

b. Engine Symptoms:

(1) Possible audible bang

(2) Increase in observed FTIT

(3) Decrease in observed N1 and N2

c. Test Stand Observation:

(1) SYSTEM FAULT light ON.

d. Data Recorded by EDU:

- Altitude
- Mach number
- PLA
- PLA rate
- Ps2
- Tt2
- Aircraft angle of attack
- Aircraft angle of yaw
- Control mode
- Time inflight
- Anti-ice (ON or OFF)
- DEEC Thermal Clearance Parameter at Time of Event

Table 1. EDU Event Code 1020: Engine Stall - IDLE and Above

Step	Procedure	Result	Corrective Action
1.	Review EDU data for event codes.	a. Events codes 1050, 1060, 1070, 1080, 1090, or 1151 present.	a. Review event data and troubleshooting for these event codes to determine if any limits exceeded. If no limits exceeded, go to step 2.
		b. No other event codes present.	b. Go to step 2.
2.	Review EDU data for other fault codes.	a. Other fault codes present.	a. Troubleshoot individual codes, then go to step 3.
		b. No other fault codes present.	b. Go to step 3.
3.	Determine if fuel supply was interrupted/cut off during event, or Pfo dropped below minimum limit per WP 205 00.	a. Fuel flow was not interrupted/cut off, and Pfo is within limits.	a. Go to step 4.
		b. Fuel flow was interrupted/cut off, or Pfo dropped below limit.	b. Troubleshoot test stand fuel delivery system.
4.	Inspect fan inlet for damage, or foreign objects. Visually inspect vanes and blades for damage. Check for disengaged or loose variable vanes.	a. DOD/FOD, loose or disengaged variable vanes not found.	a. Go to step 5.
		b. DOD/FOD, loose or disengaged variable vanes found.	b. Repair as required.
5.	Visually inspect compressor inner stator inlet shroud per figure 1.	a. Shroud material not missing.	a. Go to step 6.
		b. Any amount of shroud material missing.	b. Repair or replace components as required.
6.	Inspect augmentor nozzle and turbine exhaust sections for security. Inspect for burning, cracking, or binding.	a. Visible damage, binding, or loose components not found.	a. Go to step 7.
		b. Visible damage, binding, or loose components found.	b. Repair as required.

Table 1. EDU Event Code 1020: Engine Stall - IDLE and Above (continued)

Step	Procedure	Result	Corrective Action
7.	Visually inspect anti-ice valve part number.	a. PN 4082475 and subsequent. b. Part number prior to PN 4082475.	a. Go to step 8. b. Replace anti-ice valve. Refer to T.O. 2J-F100-53-4, WP 039 00. Go to step 8.
8.	Determine control mode in which event occurred.	a. Event occurred in PRIMARY mode. b. Event occurred in SECONDARY mode.	a. Go to step 9. b. Troubleshoot SECONDARY mode anomaly per WP 523 00.
9.	Determine if test stand Pt6 line is connected to engine Pt6 tap.	a. Test stand Pt6 line not connected to engine. b. Test stand Pt6 line connected to engine.	a. Go to step 10. b. Disconnect Pt6 line and cap engine Pt6 tap.
10.	Perform plumbing system integrity check of Ps2 and Pt6 systems per WP 675 00.	a. Plumbing check within limits. b. Plumbing check not within limits.	a. Go to step 11. b. Repair Ps2 and/or Pt6 system.
11.	Perform RCVV internal rigging check. Refer to T.O. 2J-F100-53-4, WP 104 00.	a. RCVV rigging is correct. b. RCVV rigging is not correct.	a. Go to step 13. b. Go to step 12.
12.	Perform RCVV external rigging check. Refer to T.O. 2J-F100-53-4, WP 101 00.	a. RCVV rigging is correct. b. RCVV rigging is not correct.	a. Rig internal RCVV system. Refer to T.O. 2J-F100-53-7, WP 702 00. b. Rig external RCVV system. Refer to T.O. 2J-F100-53-4, WP 101 00.
13.	Perform borescope inspection of the compressor through AP1, AP2, AP3, and AP7. Refer to T.O. 2J-F100-53-5, WP 020 00.	a. No core damage present. b. Damage to core present.	a. Go to step 14. b. Reject engine for teardown.
14.	Perform CIVV rigging check. Refer to T.O. 2J-F100-53-6, WP 705 00.	a. CIVV rigging is correct. b. CIVV rigging is not correct.	a. Go to step 15. b. Rig CIVV linkage as required.

Table 1. EDU Event Code 1020: Engine Stall - IDLE and Above (continued)

Step	Procedure	Result	Corrective Action
15.	Check throttle linkage:		
	a. Ensure MFC PLA linkage is secure and rotates smoothly.	a.1. PLA linkage normal.	a.1. Go to b.
		a.2. Damage to PLA linkage present.	a.2. Replace MFC.
	b. Check throttle rigging.	b.1. Throttle rigging correct.	b.1. Go to step 16.
		b.2. Throttle rigging out of limits.	b.2. Rig throttle as required.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
16.	Ensure EDU data has been reviewed and stored. Clear EDU data.	a. EDU cleared.	a. Go to step 17.
		b. EDU will not clear.	b. Troubleshoot error messages per WP 656 00.
17.	Run engine at IDLE. Turn SECONDARY mode ON. Monitor exhaust nozzle operation.	a. Exhaust nozzle operation normal.	a. Go to step 18.
		b. Binding or hesitation present during exhaust nozzle movement.	b. Remove primary flex shafts from exhaust nozzle actuator and CENC. Perform exhaust nozzle functional check.
18.	Turn PRIMARY mode ON. Monitor exhaust nozzle operation.	a. Exhaust nozzle operation normal.	a. Go to step 19.
		b. Binding or hesitation present during exhaust nozzle movement.	b. Remove primary flex shafts from exhaust nozzle actuator and CENC. Perform exhaust nozzle functional check.
19.	With engine at IDLE, perform leak check of air manifolds. • Anti-ice supply • CENC air supply • 13th stage bleed manifold • AFP supply • ECS connections	a. No leaks noted.	a. Go to step 20.
		b. Air leaks noted.	b. Repair and replace tubes as required.

Table 1. EDU Event Code 1020: Engine Stall - IDLE and Above (continued)

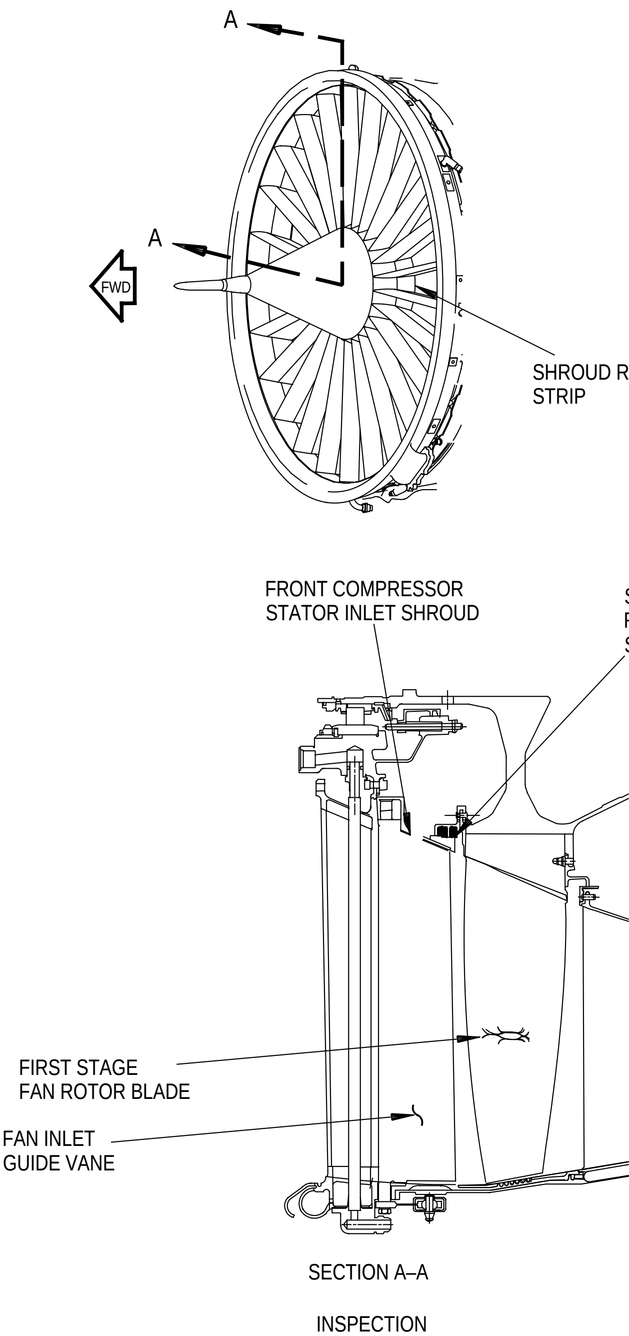
Step	Procedure	Result	Corrective Action
20.	Run engine at IDLE for 2 minutes with anti-ice switch OFF. Observe anti-ice temperature (CEDS EDU TAICE). Turn anti-ice switch ON. Maintain IDLE for 1 minute. Turn anti-ice switch OFF.	a. Anti-ice temperature increases, then decreases a minimum of 20°C (36°F) within 2 minutes after anti-ice switched OFF.	a. Go to step 21.
		b. Anti-ice temperature does not increase 20°C (36°F) when valve switched ON.	b. Troubleshoot anti-ice system per SWP 627 01, 4252 fault.
		c. Anti-ice temperature increases and does not decrease a minimum of 20°C (36°F) within 2 minutes after anti-ice switched OFF.	c. Troubleshoot anti-ice system per SWP 627 01, 4251 fault.
21.	Turn anti-ice switch ON and stabilize for 3 minutes at IDLE. Increase PLA (CEDS EDU PLAAB) to 60 degrees PLA. Observe anti-ice temperature (CEDS EDU TAICE).	a. Anti-ice temperature drops at least 20°C (36°F) within 2 minutes.	a. Go to step 22.
		b. Anti-ice temperature does not drop at least 20°C (36°F) within 2 minutes.	b. Troubleshoot per SWP 627 01, 4251 fault.
22.	Perform Ps2 dynamic pressure check per WP 675 00.	a. Analysis passes.	a. Go to step 23.
		b. Analysis fails.	b. Repair or replace component as required.
23.	Was stall operator reported?	a. Stall reported.	a. Go to step 25.
		b. Stall not reported.	b. Go to step 24.
24.	Is this a repeat/recurring non-operator reported stall?	a. Repeat/recurring non-operator reported stall.	a. Replace DEEC and go to step 25.
		b. Not repeat/recurring non-reported stall.	b. Go to step 25.
25.	Review EDU 1020 stall event transient data. Was PLA steady (within ±2 degrees) at 83 degrees or above for 6 seconds prior to stall event?	a. PLA was not at 83 degrees or above and/ or steady for 6 seconds.	a. Go to step 26.
		b. PLA was steady at 83 degrees or above for 6 seconds.	b. Go to step 31.

Table 1. EDU Event Code 1020: Engine Stall - IDLE and Above (continued)

Step	Procedure	Result	Corrective Action
26.	Determine if stall occurred during augmentation.	a. Augmentor related. b. Not augmentor related.	a. Go to step 27. b. Go to step 29.
27.	Perform augmentor fuel system analysis per WP 662 00.	a. Fuel pressure within limits. b. Fuel pressure out of limits.	a. Go to step 28. b. Repair or replace components as required.
28.	Turn anti-ice switch ON. Perform accel/decel functional check and check engine operation.	a. Anomaly does not repeat. b. Anomaly repeats.	a. Return engine to service. b. Replace components in the following order until engine operates properly per WP 213 00 and repeat steps 16 and 28. • AFC • AFPC • MFC • Core module
29.	Stabilize at IDLE for 1 minute. Check IDLE N1C2 rpm for Ground IDLE and Approach IDLE. (CEDS EDU N1C2) per WP 212 00.	a. IDLE N1C2 within limits: Ground IDLE thrust (4,025 to 4,225 rpm) and Approach IDLE thrust (F-15: 4,675 to 4,875 rpm), (F-16: 4,025 to 4,225 rpm). b. IDLE N1C2 out of limits.	a. Go to step 30. b. Troubleshoot IDLE speed out of limits per WP 514 00.
30.	Turn anti-ice switch ON. Perform accel/decel functional check and check engine operation.	a. Anomaly does not repeat. b. Anomaly repeats.	a. Return engine to service. b. Replace components in the following order until engine operates properly per WP 213 00 and repeat steps 16 and 30. • MFC • Core module

Table 1. EDU Event Code 1020: Engine Stall - IDLE and Above (continued)

Step	Procedure	Result	Corrective Action
31.	Turn anti-ice switch ON. Perform accel/decel functional check and check engine operation per WP 213 00.	a. Anomaly does not repeat. b. Anomaly repeats.	a. Return engine to service. b. Reject engine for core module replacement.



INSPECTION

AN INDICATION OF AMOUNT OF SHROUD RUBBER STRIP MISSING OR REMAINING, IS POSSIBLE BY VIEWING OR FEELING AROUND CIRCUMFERENCE ON REAR OF FRONT COMPRESSOR STATOR INLET SHROUD, JUST FORWARD OF FIRST STAGE FAN ROTOR BLADE ROOTS. SHROUD RUBBER STRIP SHOULD STICK OUT PAST REAR EDGE OF FRONT COMPRESSOR STATOR INLET SHROUD. IF ANY PIECE OF RUBBER STRIP IS MISSING AROUND CIRCUMFERENCE, REFER TO T.O. 2J–F100–53–6, WP 311 00.

39263 (48X2)

Figure 1. Front Compressor Stator Inlet Shroud - Inspection

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1030: ENGINE DIEOUT

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 8	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Start Procedures	WP 210 00
Engine Acceptance Test	WP 212 00
Acceleration/Deceleration Checks	WP 213 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Pump - Fuel, Main Gear	WP 005 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for engine dieout.

2. EDU EVENT CODE 1030: ENGINE DIEOUT.

(See Figures 1 and 2 and Table 1.)

NOTE

Event code 1030 will not be recorded by EMS for engines being tested for the F15 configuration, if one of the following conditions is satisfied:

- IAR on PLA at IDLE, and Mn less than 0.2 (octal less than 286).
- Aircraft tail number set to zeros (00-0000), PLA at IDLE, and Mn less than 0.2 (octal less than 286).

a. Cause of Event:

(1) Engine flameout or power loss: Combustion loss in gas generator section is usually associated with reduction or loss of gas generator fuel flow. Primary causes are main fuel shut off valve closed, fuel leaks, loss of fuel pump output, or engine scheduling consistent with below IDLE operation. When N2 drops below 7700 rpm, DEEC flag turns on. EDU monitors DEEC UART for this flag.

(2) Engine shut down using the fuel supply shut-off valve

b. Engine Symptoms:

(1) None

c. Data Recorded by EDU:

- Altitude
- Mach number
- PLA
- PLA rate
- Ps2
- Tt2
- Aircraft angle of attack
- Aircraft angle of yaw
- Control mode
- Time of occurrence
- Anti-ice on or off

d. Test Cell Observations:

(1) FTIT, N_1, N_2 and fuel flow decrease

(2) Audible engine noise decreases

Table 1. EDU Event Code 1030: Engine Dieout

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Determine if fuel supply was interrupted or cut off during event.	a. Fuel flow not interrupted or cut off.	a. Go to step 3.
		b. Fuel flow interrupted or cut off.	b. Troubleshoot test cell fuel delivery system.
3.	Determine control mode when event occurred.	a. Event occurred in Primary Mode.	a. Go to step 4.
		b. Event occurred in Secondary Mode.	b. Troubleshoot Secondary Mode anomaly per WP 523 00.
4.	Obtain engine envelope data from EDU. Determine if anomaly occurred in the engine envelope (See figure 1):	a. Anomaly occurred within engine envelope.	a. Go to step 5.
	• Mach number • Altitude	b. Anomaly occurred outside engine envelope.	b. If no other event or fault codes present, return engine to service.
5.	Perform following inspections:		
	a. Check condition of remote driveshaft coupling shear section (See figure 2).	a.1. Driveshaft not sheared.	a.1. Go to b.
		a.2. Driveshaft sheared.	a.2. Replace driveshaft. Perform b. before engine restart attempt.

Table 1. EDU Event Code 1030: Engine Dieout (continued)

Step	Procedure	Result	Corrective Action
5. (cont'd)	b. Perform engine rotation inspections:	b.1. Core and fan rotate freely.	b.1. Go to step 6.
	Core - Rotate gearbox driveshaft with wrench. Check for binding or unusual noises.	b.2. Core does not rotate with driveshaft.	b.2. Remove gearbox module and troubleshoot.
	Fan - Rotate 1st fan blades by hand.	b.3. Binding or abnormal noises.	b.3. Tear down engine and repair or replace damaged parts.
6.	Perform following engine visual inspections:		
	a. Inspect fan inlet and turbine exhaust for damage or foreign objects.	a.1. No damage or foreign objects.	a.1. Go to b.
		a.2. Damage or foreign objects.	a.2. Perform complete borescope inspection.
	b. Inspect for fuel leaks inside ducts.	b.1. No leaks.	b.1. Go to c.
		b.2. Fuel in fan ducts.	b.2. Repair fuel leak.
	c. Borescope rear compressor (AP7, AP2 and AP3).	c.1. No rear compressor damage.	c.1. Go to step 7.
		c.2. Rear compressor damaged.	c.2. Replace core module.
7.	Check throttle linkage:		
	a. Ensure MFC PLA linkage secure and rotates smoothly.	a.1. PLA linkage serviceable.	a.1. Go to b.
		a.2. PLA linkage damaged.	a.2. Replace MFC.
	b. Check throttle rigging.	b.1. Rigging within limits.	b.1. Go to step 8.
		b.2. Rigging out of limits.	b.2. Rig throttle.

Table 1. EDU Event Code 1030: Engine Dieout (continued)

Step	Procedure	Result	Corrective Action
8.	Inspect MFP fuel filter for contamination.	a. No contamination.	a. Go to step 9.
		b. Contamination.	b. Troubleshoot fuel system contamination per WP 305 00.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
9.	Check that EDU data has been reviewed and stored; then clear EDU data.		
10.	Attempt engine start.	a. Engine starts normally.	a. Go to step 11.
		b. Engines does not start normally.	b. Troubleshoot start anomaly per WP 509 00 or engine no-start per WP 534 00.
11.	Start engine. Stabilize 5 minutes. Check IDLE N1C2 rpm per WP 212 00.	a. N1C2 within limits.	a. Go to step 12.
		b. N1C2 out of limits.	b. Troubleshoot IDLE speed out of limits per WP 514 00.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
12.	Check that EDU data has been reviewed and stored; then clear EDU data.		
13.	Perform acceleration/ deceleration functional check and check engine operation. Replace components in following order until engine operates properly:	a. Engine starts and operates normally.	a. Return engine to service.
	• MFC	b. Engine dies out.	b. Replace next component and repeat steps 12 and 13.

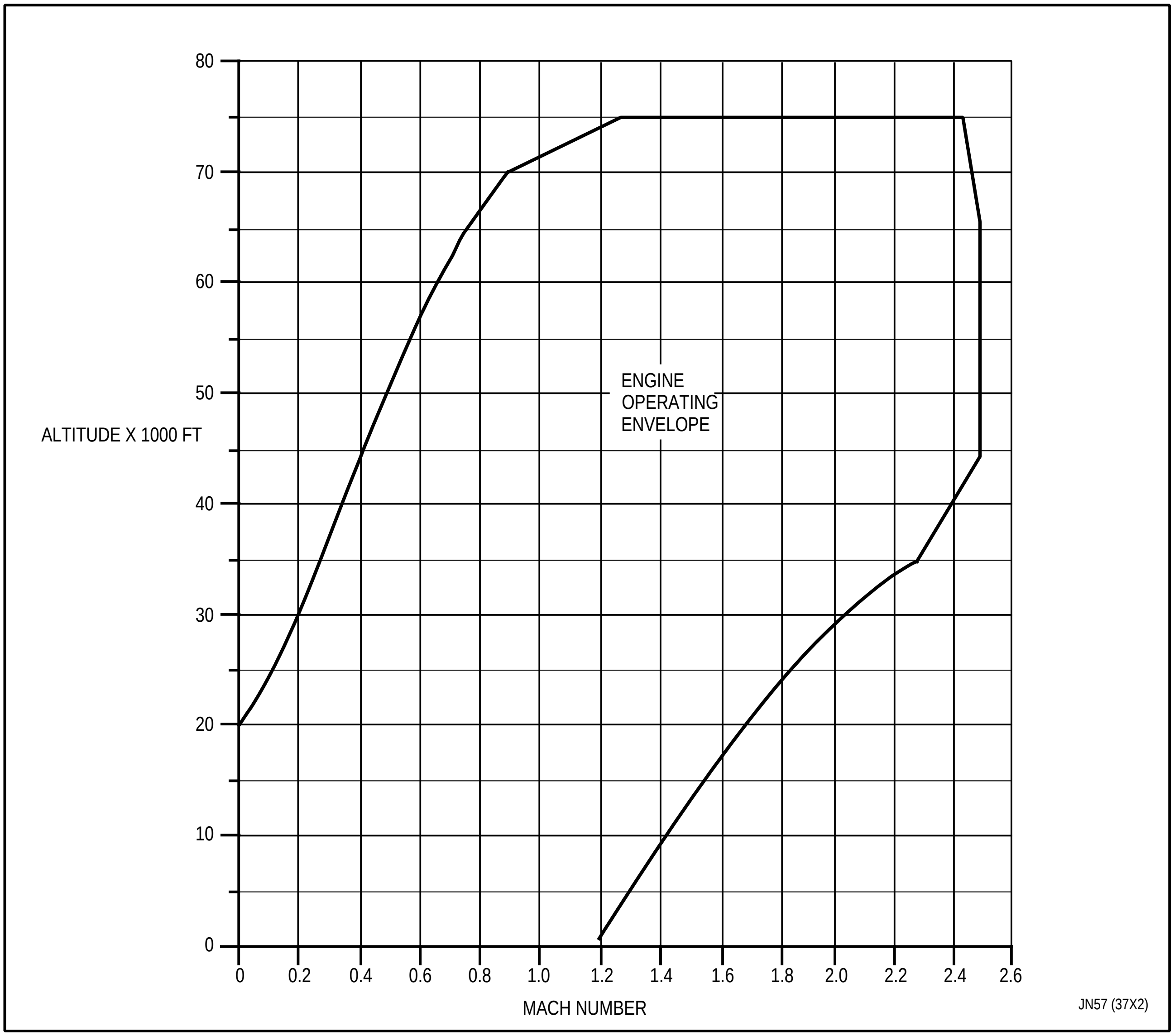


Figure 1. Engine Operating Envelope

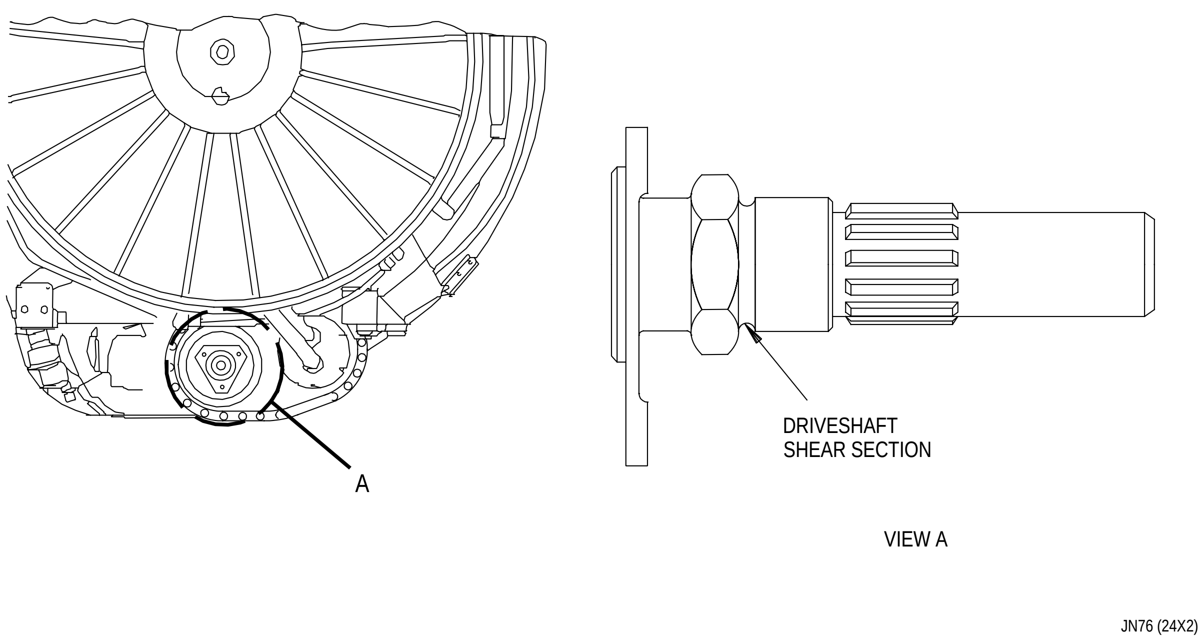


Figure 2. Starter Coupling Jaw - Inspection

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODES 1040 AND 1041: AUGMENTOR EVENTS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	18				
3	17				
4 - 7	0				
8	17				
9 - 11	0				
12 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Acceleration/Deceleration Checks	WP 213 00
Engine Troubleshooting - General	WP 501 00
EPR vs N1C2 Out of Limits, Intermediate (MIL) - Primary Mode	WP 515 00
Ignition System Anomaly	WP 518 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Revising EDU and DEEC Software Using CEDS	WP 658 00
Augmentor Fuel System Analysis	WP 662 00
Ignition System Analysis	WP 664 00
DEEC Pressure Sensing System Analysis	WP 675 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Igniter - Spark, Gas Turbine Engine Augmentor	WP 025 00
Nozzle - Convergent, Actuation System, Integrity Check	WP 040 00
Detector - Augmentor Light-off	WP 041 00
Engine	T.O. 2J-F100-53-5
Flameholder Assembly, Augmentor Igniter - Inspection	WP 421 00
Augmentor Spray Manifold	TBD

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Logic (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	EDU EVENT CODE 1040: AUGMENTOR EVENT	
	OHMMETER	PMS-6 OR EQUIVALENT
3	EDU EVENT CODE 1041: AUGMENTOR BLOWOUT	
	OHMMETER	PMS-6 OR EQUIVALENT

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for augmentor events.

2. EDU EVENT CODE 1040: AUGMENTOR EVENT.

(See Figure 1 and Table 1.)

a. Cause of Event:

(1) Engine sequences to augmentor and augmentor combustion does not occur due to lack of ignition or proper fuel scheduling. No lights are detected by DEEC pressure and nozzle area parameters. After first no light detection, DEEC will attempt to light augmentor (recycle) three times. No light events are recorded based upon the following additional criteria:

(2) Ground and takeoff region (gear up plus 30 seconds): Event recorded after first no light detected.

(3) Inflight (excluding upper left portion of envelope, PT2 2.7 psia or less): Event recorded after initial no light and three unsuccessful no light recycle attempts.

b. Engine Symptoms:

(1) Successive nozzle recycling

c. Data Recorded by EDU:

- Time of occurrence
- Altitude
- Mach number
- PLA
- PLA rate
- Ps2
- Tt2
- Aircraft angle of attack
- Aircraft angle of yaw
- Anti-ice (ON or OFF)

Table 1. EDU Event Code 1040: Augmentor Event

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Visually inspect augmentor for damage:	a. Parts not damaged.	a. Go to step 3.
		b. Parts damaged.	b. Repair or replace parts.
	• Flameholder • Flameholder Gap (especially between nosepiece and inner and outer shrouds within 2 inches of igniters) • Sprayrings (especially Segment 1 shield, brackets, and ignition orifices at igniters) • Igniters (for burning or buckling) • LOD lens		
3.	Check security of LOD mounting and electrical cable connector.	a. LOD secure.	a. Go to step 4.
		b. LOD loose.	b. Repair LOD.
4.	Determine when anomaly occurred.	a. Anomaly occurred during augmentor sequencing (Augmentor lit).	a. Record augmentation segment if known. Go to step 9.
		b. Anomaly occurred at augmentor initiation (no flame).	b. Go to step 5.
5.	Visually inspect generator stator for:	a. Generator serviceable.	a. Go to step 6.
	• Loose mounting • Cracked housing • Loose connectors • Contamination or arcing inside connectors	b. Generator not serviceable.	b. Clean connectors. Otherwise, repair or replace generator or ignition cables, as required.

Table 1. EDU Event Code 1040: Augmentor Event (continued)

Step	Procedure	Result	Corrective Action
6.	Check generator stator ignition circuits. Perform following resistance checks (See figure 1): CONN J119 PINS 1. E to F 2. E to GND 3. F to GND 4. J to K 5. J to GND 6. K to GND	a. Resistance checks within limits: 1. LT 25 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 25 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	a. Go to step 7.
		b. Resistance checks out of limits.	b. Replace generator.
7.	Check AFC ignition switch circuits. Perform the following resistance checks (See figure 1): CONN J104 PINS 1. A to B 2. A to GND 3. B to GND 4. D to E 5. D to GND 6. E to GND	a. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	a. Go to step 8.
		b. Resistance checks out of limits.	b. Replace fill switch and ignition relay module.
8.	Perform augmentor ignition system functional check.	a. Augmentor ignites normally.	a. Go to step 9.
		b. Augmentor does not ignite normally.	b. Troubleshoot augmentor ignition anomaly.
9.	Perform DEEC pressure sensing system analysis.	a. System fails analysis.	a. Repair or replace system components, as required. Go to step 10.
		b System passes analysis.	b. Go to step 10.

Table 1. EDU Event Code 1040: Augmentor Event (continued)

Step	Procedure	Result	Corrective Action
10.	Run engine at IDLE. Cycle IDLE EXHAUST NOZZLE switch: RESET-OFF-RESET.	a. Exhaust nozzle operates normally. b. Exhaust does not operate normally.	a. Go to step 11. b. Disconnect primary flex shafts from exhaust nozzle actuator and CENC. Perform exhaust nozzle functional check.

WARNING

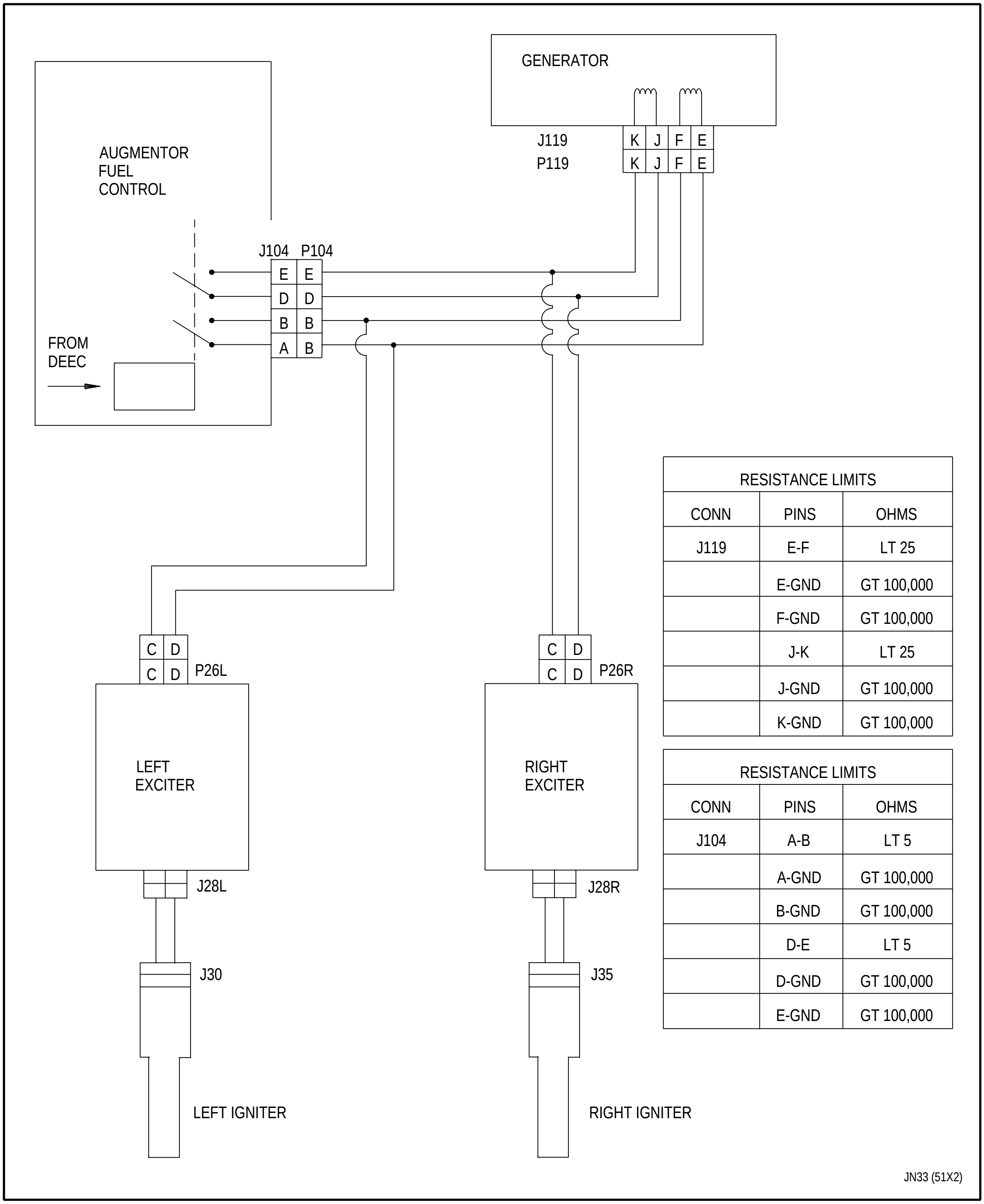
Engine bleed air manifolds and tubing are hot. Do not touch these areas while checking for air leaks

Step	Procedure	Result	Corrective Action
11.	Check 13th stage bleed, anti-ice, CENC, and augmentor fuel pump air tubes for leaks.	a. No leaks found. b. Leaks found.	a. Go to step 12. b. Repair leaks and go to step 12.
12.	Perform augmentor fuel system analysis.	a. System fails analysis. b. System passes analysis.	a. Repair or replace components, as required. b. Go to step 13.

NOTE

Data cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
13.	Check that EDU data has been reviewed and stored; then clear EDU data.		
14.	Perform acceleration/ deceleration functional check and check augmentor operation. Replace components in following order until augmentor operates normally: • LOD DEEC AFC • Augmentor sprayring • (Replace manifold in • which anomaly occurred. See step 4.)	a. Augmentor operates normally. b. Augmentor does not operate normally.	a. Return engine to service. b. Replace the next component and repeat steps 13 and 14.



RESISTANCE LIMITS		
CONN	PINS	OHMS
J119	E-F	LT 25
	E-GND	GT 100,000
	F-GND	GT 100,000
	J-K	LT 25
	J-GND	GT 100,000
	K-GND	GT 100,000

RESISTANCE LIMITS		
CONN	PINS	OHMS
J104	A-B	LT 5
	A-GND	GT 100,000
	B-GND	GT 100,000
	D-E	LT 5
	D-GND	GT 100,000
	E-GND	GT 100,000

Figure 1. Augmentor Ignition System Schematic - (Generator Stator and AFC Ignition Switch Resistance Checks)

3. EDU EVENT CODE 1041: AUGMENTOR BLOWOUT.
(See figure 1 and Table 2.)

a. Cause of Event:

(1) Loss of augmentor combustion during normal augmentor operation. Blowouts are detected by DEEC via light-off detector (LOD) signal or DEEC pressure and nozzle area parameters. After first blowout detection, DEEC will attempt to re-light (recycle) augmentor three times. Blowout events are recorded based upon the following criteria:

(a) Ground and takeoff region (gear up plus 30 seconds): Event recorded after first blowout detected.

(b) Inflight (excluding upper left portion of envelope, PT2 2.7 psia or less): Event recorded after initial blowout detected and three unsuccessful recycle attempts.

b. Engine Symptoms:

(1) Successive nozzle recycling without sustained augmentation.

c. Data Recorded by EDU.

- Time of occurrence
- Altitude
- Mach number
- PLA
- PLA rate
- Ps2
- Tt2
- Aircraft angle of attack
- Aircraft angle of yaw
- Control mode
- Anti-ice (ON or OFF)

Table 2. EDU Event Code 1041: Augmentor Blowout

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present. b. No events or faults present.	a. Troubleshoot individual event or fault codes. b. Go to step 2.
2.	Visually inspect augmentor area for damage: • Flameholder • Flameholder Gap (especially between nosepiece and inner and outer shrouds within 2 inches of igniters) • Sprayrings (especially Segment 1 shield, brackets, and ignition orifices at igniters) • Igniters (for burning or buckling) • LOD lens	a. Parts not damaged. b. Parts damaged.	a. Go to step 3. b. Repair or replace parts.
3.	Check security of LOD mounting and electrical cable connector.	a. LOD secure. b. LOD loose.	a. Go to step 4. b. Repair LOD.
4.	Review 5000-series Advisory Fault Codes.	a. Advisory Fault Code 5002 present. b. Advisory Fault Code 5002 not present.	a. Go to step 5. b. Go to step 9.
5.	Visually inspect generator stator for: • Loose mounting • Cracked housing • Loose connectors • Contamination or arcing inside connectors	a. Generator serviceable. b. Generator not serviceable.	a. Go to step 6. b. Clean connectors. Otherwise, repair or replace generator and/or ignition cable.

Table 2. EDU Event Code 1041: Augmentor Blowout (continued)

Step	Procedure	Result	Corrective Action
6.	Check generator stator ignition circuits. Perform following resistance checks (See figure 1): CONN J119 PINS 1. E to F 2. E to GND 3. F to GND 4. J to K 5. J to GND 6. K to GND	a. Resistance checks within limits: 1. LT 25 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 25 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS b. Resistance checks out of limits.	a. Go to step 7. b. Replace generator.
7.	Check AFC ignition switch circuits. Perform the following resistance checks (See figure 1): CONN J104 PINS 1. A to B 2. A to GND 3. B to GND 4. D to E 5. D to GND 6. E to GND	a. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS b. Resistance checks out of limits.	a. Go to step 8. b. Replace fill switch and ignition relay module.
8.	Perform augmentor ignition system functional check.	a. Augmentor ignites normally. b. Augmentor does not ignite normally.	a. Go to step 9. b. Troubleshoot augmentor ignition anomaly.
9.	Perform DEEC pressure sensing system analysis.	a. System fails analysis. b. System passes analysis.	a. Repair or replace system components, as required. Go to step 10. b. Go to step 10.

Table 2. EDU Event Code 1041: Augmentor Blowout (continued)

Step	Procedure	Result	Corrective Action
10.	Run engine at IDLE. Cycle IDLE EXHAUST NOZZLE switch: RESET-OFF-RESET.	a. Exhaust nozzle operates normally. b. Exhaust does not operate normally.	a. Go to step 11. b. Disconnect primary flex shafts from exhaust nozzle actuator and CENC. Perform exhaust nozzle functional check.

WARNING

Engine bleed air manifolds and tubing are hot. Do not touch these areas while checking for air leaks, injury to personnel could result.

Step	Procedure	Result	Corrective Action
11.	Check 13th stage bleed, anti-ice, CENC, and augmentor fuel pump air tubes for leaks.	a. No leaks found. b. Leaks found.	a. Go to step 12. b. Repair leaks and go to step 12.
12.	Perform augmentor fuel system analysis.	a. System fails analysis. b. System passes analysis.	a. Repair or replace components, as required. b. Go to step 13.

NOTE

Data cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
13.	Check that EDU data has been reviewed and stored; then clear EDU data.		
14.	Perform acceleration/ deceleration functional check. Check augmentor operation. Replace components in following order until augmentor operates normally: • LOD • DEEC • AFC • Augmentor sprayring (Replace manifold in which anomaly occurred. See step 4.)	a. Augmentor operates normally. b. Augmentor does not operate normally.	a. Return engine to service. b. Replace next component and repeat steps 13 and 14.

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1050:
HOT GROUND START

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	22				
6 Blank	22				
7 Deleted	22				
8 Blank Deleted	22				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00
Engine Start Procedures	WP 210 00
IDLE Functional Check	WP 216 00
Main Fuel Pump Fuel Pressure Analysis	WP 661 00
Compressor Bleed System Functional Check	WP 667 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Pump - Gear, Main Fuel	WP 005 00
Cylinders - Actuating, Linear, Variable Vane, Rear Compressor - Rigging	WP 101 00
Rear Compressor Variable Vane Internal Rigging Check	WP 104 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Logic (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for hot ground start.

2. EDU EVENT CODE 1050: HOT GROUND START.

(See Table 1.)

a. Cause of Event:

(1) Hot start detected on ground when FTIT is greater than or equal to 800.0°C for 5 seconds or greater than or equal to 1098.8°C for 0.75 second, and engine is below IDLE.

b. Engine Symptoms:

(1) None

c. Data Recorded by EDU:

- Time in each FTIT level
- Duration in FTIT level 1 (greater than or equal to 800.0°C)
- Duration in FTIT level 2 (greater than or equal to 1098.8°C)
- Duration in FTIT level 3 (greater than or equal to 1112.2°C)
- Duration in FTIT level 4 (greater than or equal to 1134.4°C)
- Maximum FTIT
- N2 and Tt2 at start initiation (Throttle in IDLE)
- N2 at ignition
- Ignition time
- N2, RCVV position, and control mode at overtemperature
- Anti-ice (ON or OFF)

Table 1. EDU Event Code 1050: Hot Ground Start

Step	Procedure	Result	Corrective Action
NOTE If System Fault Code 4081 (Mn Signal) is present, and FTIT is within limits (step 1.), EDU Event Code 1050 troubleshooting is not required.			
1.	Determine if engine FTIT limits exceeded. Obtain time in FTIT level and maximum FTIT from EDU event data. Compare data to WP 205 00, table 5.	a. FTIT within limits. b. FTIT not within limits.	a. Go to step 2. b. Perform corrective action listed per WP 205 00, table 5.
2.	Review event and fault data.	a. Events or faults present. b. No events or faults present.	a. Troubleshoot individual event or fault codes. b. Go to step 3.
3.	Determine control mode when event occurred.	a. Event occurred in PRIMARY mode. b. Event occurred in SECONDARY mode.	a. Go to step 4. b. Troubleshoot SECONDARY mode anomaly.
4.	Check following data collected during hot start:		
	a. RCVV position.	a.1. RCVV position between -37 to -30 degrees. a.2. RCVV position more than -30 degrees.	a.1. Go to b. a.2. Go to step 9.
	b. Ignition time, Tt2.	b.1 Ignition time less than limit. b.2. Ignition time more than limit.	b.1. Go to c. b.2. Troubleshoot engine no-start (EDU Event Code 1120).
	c. N2 rpm at ignition	c.1. N2 more than 3,000 rpm. c.2. N2 less than 3,000 rpm.	c.1. Go to step 5. c.2. Check starter motor operation (See EDU Event Code 1120). If within limits, perform engine start. If start is normal, return engine to service.
5.	Perform engine start in PRIMARY mode per WP 210 00.	a. Start anomaly occurs. b. Engine starts normally.	a. Go to step 6. b. Return engine to service.

Table 1. EDU Event Code 1050: Hot Ground Start (continued)

Step	Procedure	Result	Corrective Action
6.	Inspect MFP filter for contamination. Refer to T.O. 2J-F100-53-4, WP 005 00.	a. No contamination. b. Contamination.	a. Go to step 7. b. Troubleshoot fuel system contamination per WP 305 00.
7.	Borescope rear compressor (AP7, AP2 and AP3). Refer to T.O. 2J-F100-53-5, WP 020 00.	a. Rear compressor within borescope limits. b. Rear compressor out of borescope limits.	a. Go to step 8. b. Repair or replace rear compressor.
8.	Check RCVV internal rigging. Refer to T.O. 2J-F100-53-4, WP 104 00.	a. RCVV rigging is correct. b. RCVV rigging is not correct.	a. Go to step 10. b. Go to step 9.
9.	Check RCVV external rigging. Refer to T.O. 2J-F100-53-4, WP 101 00.	a. RCVV rigging is correct. b. RCVV rigging is not correct.	a. Rig internal RCVV system. Refer to T.O. 2J-F100-53-7, WP 702 00. b. Rig external RCVV system. Refer to T.O. 2J-F100-53-4, WP 101 00.
10.	Perform compressor bleed system functional check per WP 667 00.	a. System functions normally. b. System does not function normally.	a. Go to step 11. b. Replace parts.
11.	Perform MFP fuel pressure analysis per WP 661 00.	a. Fuel pressure within limits. b. Fuel pressure out of limits.	a. Go to step 12. b. Replace MFP. Refer to T.O. 2J-F100-53-4, WP 005 00.
12.	Perform IDLE functional check per WP 216 00. Check engine operation.	a. Engine starts and operates properly. b. Engine does not start or operate properly.	a. Return engine to service. b. Replace components in following order until engine operates properly and repeat steps 11 and 12. • MFC RCVV EHV • MFC • Core module (if hot start repeats)

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1060: HOT AIR START

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	22				
6 Blank	22				
7	22				
8	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Depot Engine Test	T.O. 2J-F100-11-2
Engine Start Procedures	WP 210 00
Idle Functional Check	WP 216 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Downloading and Reviewing Data Using DTS	SWP 651 01
Main Fuel Pump Fuel Pressure Analysis	WP 661 00
Compressor Bleed System Functional Check	WP 667 00
Depot Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Pump - Gear, Fuel Main	WP 005 00
Cylinders - Actuating, Linear, Variable Vane, Rear Compressor - Rigging	WP 101 00
Rear Compressor Variable Vane Internal Rigging Check	WP 104 00
Depot Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for hot air start.

2. EDU EVENT CODE 1060: HOT AIR START.

(See Figure 1 and Table 1.)

a. Cause of Event:

(1) Hot start detected in air when FTIT is greater than or equal to 870.0°C for 5.00 seconds or greater than or equal to 1098.8°C for 0.75 second.

b. Engine Symptoms:

(1) None.

c. Data Recorded by EDU:

- Time in each FTIT level
- Duration in FTIT level 1 (greater than or equal to 870.0°C)
- Duration in FTIT level 2 (greater than or equal to 1098.8°C)
- Duration in FTIT level 3 (greater than or equal to 1112.2°C)
- Duration in FTIT level 4 (greater than or equal to 1134.4°C)
- Maximum FTIT
- Tt2 at maximum FTIT
- Altitude, airspeed (KCAS), N2 and FTIT, Tt2 at start initiation (throttle in IDLE)
- N2 at ignition
- N2, RCVV position, and control mode at overtemperature
- Time of occurrence
- Ignition time

Table 1. EDU Event Code 1060: Hot Air Start

Step	Procedure	Result	Corrective Action
1.	Determine if FTIT limits exceeded. Obtain time in FTIT level and maximum FTIT from EDU event data. Compare data to Chart 1.	a. FTIT within limits.	a. Go to step 2.
		b. FTIT not within limits.	b. Perform corrective action per Chart 1.
2.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No events or faults present.	b. Go to step 3.
3.	Determine control mode when event occurred.	a. Event occurred in PRIMARY mode.	a. Go to step 4.
		b. Event occurred in SECONDARY mode.	b. Troubleshoot SECONDARY mode anomaly.

Chart 1. Engine Overtemperature (Hot Air Start) Limits and Corrective Action

EDU Level	Overtemperature Limits		Corrective Action Code	
	FTIT		Time Duration Range - Seconds	
	°C	°F	0 to 5	GT 5
LEV1	870 to 1098	1598 to 2009	A	A
LEV2	1099 to 1112	2010 to 2034	A	B
LEV3	1113 to 1134	2035 to 2073	B	C
LEV4	GT 1134	GT 2073	C	C

Code	Corrective Action
A	1. Troubleshoot and correct cause of overtemperature.
B	1. Record temperature and duration in engine log and turbine AFTO Form 44 (Core and Fan Drive Turbine modules) for each occurrence.
	2. Inspect exhaust duct for foreign material.
	3. Perform N_1 and N_2 rotation checks.
	4. Borescope combustion section through AP4 and AP6.
	5. Investigate and correct cause of overtemperature.
C	1. Terminate test. Perform combustion section teardown inspection.

Table 1. EDU Event Code 1060: Hot Air Start (continued)

Step	Procedure	Result	Corrective Action
4.	Check following data collected during hot start:		
	a. Airspeed and altitude. (See figure 1.)	a.1. Airspeed and altitude within airstart envelope.	a.1. Go to b.
		a.2. Airspeed and altitude outside airstart envelope.	a.2. Go to step 5.
	b. RCVV position.	b.1. RCVV position between -37 to -30 degrees.	b.1. Go to c.
		b.2. RCVV position more than -30 degrees.	b.2. Go to step 9.
	c. Ignition time, Tt2	c.1. Ignition time less than limit.	c.1. Go to d.
		c.2. Ignition time more than limit.	c.2. Troubleshoot engine no-start (EDU Event Code 1120).
	d. N2 rpm at ignition.	d.1. N2 more than 3,000 rpm.	d.1. Go to step 5.
		d.2. N2 less than 3,000 rpm.	d.2. Check starter motor operation (See EDU Event Code 1120). If within limits, perform engine start. If start is normal, return engine to service.
5.	Perform engine start in PRIMARY mode per WP 210 00.	a. Start anomaly occurs.	a. Go to step 6.
		b. Engine starts normally.	b. Return engine to service.
6.	Inspect MFP filter for contamination. Refer to T.O. 2J-F100-53-4, WP 005 00.	a. No contamination.	a. Go to step 7.
		b. Contamination.	b. Troubleshoot fuel system contamination per WP 305 00.

Table 11. EDU Event Code 1060: Hot Air Start (continued)

Step	Procedure	Result	Corrective Action
7.	Borescope rear compressor (AP7, AP2 and AP3). Refer to T.O. 2J-F100-53-5, WP 020 00.	a. Rear compressor within borescope limits. b. Rear compressor out of borescope limits.	a. Go to step 8. b. Repair or replace rear compressor.
8.	Check RCVV internal rigging. Refer to T.O. 2J-F100-53-4, WP 104 00.	a. RCVV rigging is correct. b. RCVV rigging is not correct.	a. Go to step 10. b. Go to step 9.
9.	Check RCVV external rigging. Refer to T.O. 2J-F100-53-4, WP 101 00.	a. RCVV rigging is correct. b. RCVV rigging is not correct.	a. Rig internal RCVV system. Refer to T.O. 2J-F100-53-7, WP 702 00. b. Rig external RCVV system. Refer to T.O. 2J-F100-53-4, WP 101 00.
10.	Perform compressor bleed system functional check per WP 667 00.	a. System functions normally. b. System does not function normally.	a. Go to step 11. b. Replace parts.
11.	Perform MFP fuel pressure analysis per WP 661 00.	a. Fuel pressure within limits. b. Fuel pressure out of limits.	a. Go to step 12. b. Replace MFP. Refer to T.O. 2J-F100-53-4, WP 005 00.
12.	Perform IDLE functional check per WP 216 00. Check engine operation.	a. Engine starts and operates properly. b. Engine does not start or operate properly.	a. Return engine to service. b. Replace components in following order until engine operates properly and repeat steps 11 and 12. • MFC RCVV EHV • MFC • Core module (if hot start repeats)

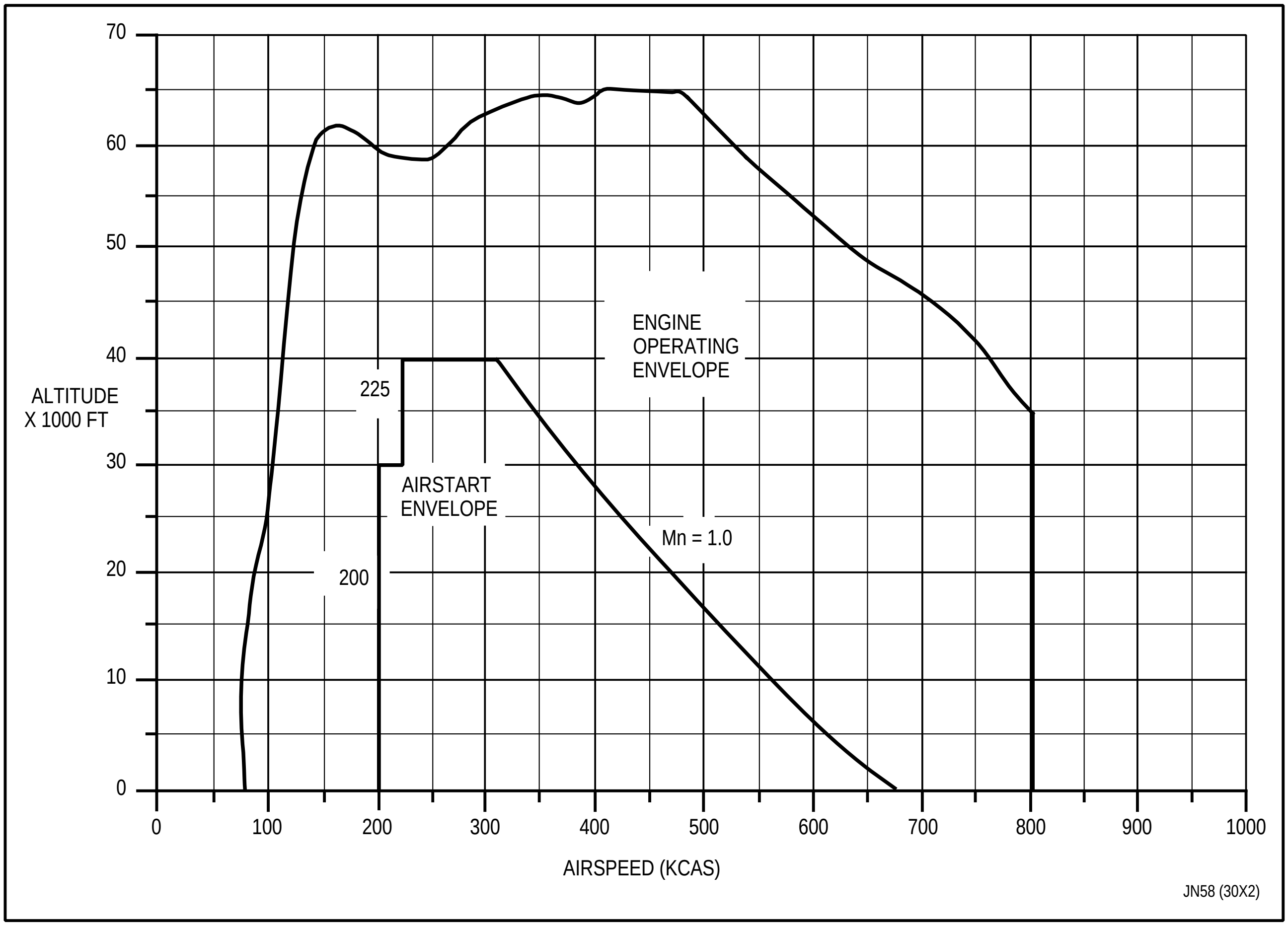


Figure 1. Engine Airstart Envelope - Primary Mode

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1070: FTIT OVERTEMPERATURE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	0				
6 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00
Acceleration/Deceleration Checks	WP 210 00
Idle Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Secondary Mode Anomaly	WP 523 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
DEEC Pressure Sensing System Analysis	WP 675 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for FTIT overtemperature detected by EDU.

2. EDU EVENT CODE 1070: FTIT OVERTEMPERATURE.
(See Table 1.)

a. Cause of Event:

(1) EDU detects FTIT over 1855°F (1013°C) for at least five seconds, or over 1891°F (1033°C) for at least one second.

(2) Excessive fuel flow scheduling resulting from control system malfunction.

b. Engine Symptoms:

(1) None

c. Data Recorded by EDU:

- Control mode
- Time at each FTIT overtemperature level
- Maximum FTIT
- Vmax status
- Time of occurrence

Table 1. EDU Event Code 1070: FTIT Overtemperature

Step	Procedure	Result	Corrective Action
1.	Review EDU event data and note time at FTIT level and maximum FTIT.		Perform required corrective action. Go to step 2.
2.	Review event and fault data.	a. Events or faults.	a. Troubleshoot individual event or fault codes.
		b. No events or faults.	b. Go to step 3.
3.	Determine control mode when event occurred.	a. Event occurred in Primary Mode.	a. Go to step 4.
		b. Event occurred in Secondary Mode.	b. Troubleshoot Secondary Mode anomaly.
4.	Perform DEEC pressure sensing system analysis.	a. System fails analysis.	a. Repair or replace system component. Go to step 5.
		b. System passes analysis.	b. Go to step 5.
5.	Perform IDLE functional check. Monitor FTIT parameters as follows and compare to IDLE FTIT spread and instability limits in Chart 1.	a. Parameters out of limits: 1. Individual FTIT probes to FTITAV 2. FTITA to FTITAV 3. FTITB to FTITA	a. Replace probes as follows: 1. Malfunctioning probes 2. Probes 1,3,5, and 7. 3. Probes 2,4, and 6.
	• Individual FTIT probes to FTITAV • FTITA (word 0056) to FTITAV (word 1005) • FTITB (word 0057) to FTITA (word 1005)	b. Parameters within limits	b. Go to step 6.

Chart 1. Engine Overtemperature Limits and Corrective Action (Excluding Engine Starts)

EDU LEVEL	FTIT °F	FTIT (°C)	Time Duration Range: 0 to 35 Secs.	Time Duration Range: 6 Sec. - 2 Mins.	Time Duration Range: GT 2 Mins.
LEV1	2008 to 2034	(1098 to 1112)	A	B	B
LEV2	2035 to 2073	(1113 to 1134)	B	C	C
LEV3	2035 to 2073	(1113 to 1134)	C	C	C
LEV4	GT 2073	(GT 1134)	C	C	C

Code	Corrective Action
A	1. Record temperature and duration in engine log and turbine AFTO Form 44 (Core and Fan Drive Turbine modules) for each occurrence. 2. Troubleshoot and correct cause of overtemperature. 3. Inspect exhaust duct for foreign material.
B	1. Same as Code A. 2. Borescope combustor and turbines.
C	1. Same as code A. 2. Terminate test. Perform combustion section teardown inspection.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

6.	Check that EDU data has been reviewed and stored; then clear EDU data.		
7.	Perform acceleration/ deceleration functional check with EMSE in auto search mode. Check for EDU Event Code 1070. Replace components in following order until engine operates properly:	a. EDU Event Code 1070 does not repeat.	a. Return engine to service.
	• DEEC • FTIT probes • Temperature cable • MFC	b. EDU Event Code 1070 repeats.	b. Replace next component and repeat steps 6 and 7.

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1080:
N1 OVERSPEED

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00
Downloading and Reviewing Data Using CEDS	WP 651 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for N1 overspeed event detected by EDU.

2. EDU EVENT CODE 1080: N1 OVERSPEED. (See Table 1.)

a. Cause of Event:

(1) EDU detected low rotor overspeed when N1 was more than 12,400 rpm for 0.75 seconds.

(2) Excessive fuel flow scheduling, in conjunction with high N2 and FTIT, or a control system malfunction in CIVV or CENC circuits.

b. Engine Symptoms:

(1) None

(2) Transfer to Secondary Mode if System Fault Code 4080 - N1 Overspeed is detected by DEEC.

c. Data Recorded by EDU:

- Control mode
- Duration of overspeed
- Maximum N1 rpm
- Tt2 at maximum N1 rpm
- Time of occurrence

d. Test Cell Observations (EDU Event Code 1080 only)

(1) System fault light on

e. Additional Test Cell Observations (EDU Event Code 1080 with System Fault Code 4080):

(1) SECONDARY CAUTION light on

(2) ENGINE CAUTION light on

(3) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 1. EDU Event Code 1080: N1 Overspeed

Step	Procedure	Result	Corrective Action
1.	Review EDU Event data.	a. No corrective action required. b. Engine requires corrective action.	a. Return engine to service. b. Discontinue troubleshooting. Reject Fan and FDT for N1 overspeed inspection. Reject DEEC and MFC for bench testing.

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1090:
N2 OVERSPEED

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00
Downloading and Reviewing Data Using CEDS	WP 651 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for N2 overspeed event detected by EDU.

2. EDU EVENT CODE 1090: N2 OVERSPEED.

(See Table 1.)

a. Cause of Event:

(1) EDU detected high rotor overspeed when N2 was over limits.

(2) Excessive fuel flow schedule resulting from control system malfunction

b. Engine Symptoms:

(1) None

(2) Transfer to Secondary Mode if System Fault Code 4090 - N2 overspeed is detected by DEEC.

c. Data Recorded by EDU:

- Control mode
- Duration of overspeed
- Maximum N2 rpm
- Tt2 during overspeed
- Time of occurrence

d. Test Cell Observations (EDU Event Code 1090 only):

(1) SYSTEM FAULT light on

e. Additional Test Cell Observations (EDU Event Code 1090 with System Fault Code 4090):

(1) SECONDARY CAUTION light on

(2) ENGINE CAUTION light on

(3) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 1. EDU Event Code: 1090 N2 Overspeed

Step	Procedure	Result	Corrective Action
1.	Review EDU Event data. Compare to engine operating limits.	a. No corrective action required.	a. Return engine to service.
		b. Engine requires corrective action.	b. Discontinue troubleshooting. Reject engine for N2 overspeed inspection. Reject DEEC and MFC for bench testing.

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1120: ENGINE NO-START

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	22				
3 - 7	0				
8 - 9	22				
10 - 11	0				
12 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Downloading and Reviewing Data Using CEDS	WP 651 00
Downloading and Reviewing Data Using DTS	SWP 651 01
Main Fuel Pump Fuel Pressure Analysis	WP 661 00
Ignition System Analysis	WP 664 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Pump - Gear, Main Fuel	WP 005 00
Cylinders - Actuating, Linear, Variable Vane, Rear Compressor - Rigging	WP 101 00
Rear Compressor Variable Vane Internal Rigging Check	WP 104 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	EDU Event Code 1120: Engine No Start	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for engine no-start.

2. EDU EVENT CODE 1120: ENGINE NO-START.

(See Figures 1 through 3, and Table 1.)

a. Cause of Event:

(1) Engine fails to reach IDLE after start attempt: EDU checks for ignition (Pb rise) during start attempt. If ignition is present, but throttle is in CUTOFF before engine reaches IDLE, EDU begins recording data. This event will be recorded when engine dry or wet motoring is accomplished.

b. Conditions Preventing Fault Detection or Fault Recording:

(1) If a hot-start (1050 or 1060) has been previously declared.

(2) If PLA signal or UART signal is faulty, or

(3) During a cold flow check, which is determined when:

- Aircraft is on the ground, GND = 0 (when IAR = ON and MN is less than 0.2)
- FTIT less than 932°F (500°C) and N_2 less than 4200 rpm.

c. Engine Symptoms:

(1) None

d. Data Recorded by EDU:

- Time of occurrence
- Tt2, N2, FTIT, airspeed (KCAS), and altitude (at IDLE)
- Ignition status (Pb rise indication)
- Ignition time
- N2 (at ignition)
- Start time (at CUTOFF)
- RCVV position and control mode at CUTOFF
- Control mode
- Maximum FTIT
- Anti-ice on or off

Table 1. EDU Event Code 1120: Engine No-Start

Step	Procedure	Result	Corrective Action
NOTE If fault was recorded during a wet or dry engine motoring, troubleshooting is not required.			
1.	Determine control mode when event occurred.	a. Event occurred in Primary Mode.	a. Go to step 2.
		b. Event occurred in Secondary Mode.	b. Troubleshoot Secondary Mode anomaly.
2.	Determine if event occurred during airstart attempt.	a. Event occurred during airstart attempt.	a. Go to step 3.
		b. Event occurred on the ground.	b. Go to step 5.
3.	Determine if start attempt was initiated within airstart envelope. Obtain following data from EDU Event data. • Airspeed (KCAS) • Altitude (Ft)	a. Start was initiated within airstart envelope.	a. Go to step 4.
	Compare data to figure 3.	b. Start was initiated outside airstart envelope.	b. Perform idle functional check. If check successful, return engine to service.
4.	Determine if start was initiated (throttle to IDLE) at the proper N2 and FTIT. Obtain N2 and FTIT during start from the EDU Event data.	a. The following limits were not exceeded during start attempt: • N2 between 3200 to 5600 rpm • FTIT less than 700°C.	a. Go to step 5.
		b. The above limits were exceeded.	b. Perform idle functional check. If check successful, return engine to service.

Table 1. EDU Event Code 1120: Engine No-Start (continued)

Step	Procedure	Result	Corrective Action
5.	If no N2 rpm indication present during start attempt, perform following inspections. If N2 within limits, go to step 6.		
	a. Check driveshaft shear section (See figure 1).	a.1. Driveshaft not sheared.	a.1. Go to b.
		a.2. Driveshaft sheared.	a.2. Replace driveshaft. Perform b. before engine restart attempt.
	b. Inspect fan inlet and turbine exhaust for damage or foreign objects.	b.1. No damage or foreign objects.	b.1. Go to c.
		b.2. Damage or foreign objects.	b.2. Perform complete borescope inspection.
	c. Check test cell N2 rpm instrumentation.	c.1. Instrumentation functions properly.	c.1. Go to step 6.
		c.2. Instrumentation does not function properly.	c.2. Repair test cell instrumentation.
6.	Perform following engine visual inspections:		
	a. Perform engine rotation inspections: Core - Rotate input shaft on gearbox with wrench. Check for binding or unusual noises. Fan - Rotate 1st fan blades by hand.	a.1. Engine rotates freely.	a.1. Go to b.
		a.2. Binding or abnormal noises.	a.2. Tear down engine and repair.
	b. Inspect for fuel leakage inside fan ducts.	b.1. No leaks.	b.1. Go to c.
		b.2. Fuel in fan ducts.	b.2. Repair fuel leak.
	c. Check test cell starter gearbox for proper operation. • Coupling jaw alignment • Disengagement switch • Air starter pressure supply (SIP)	c.1. Test cell starter operates normally.	c.1. Go to step 7.
		c.2. Test cell starter does not operate normally.	c.2. Repair test cell starter.

Table 1. EDU Event Code 1120: Engine No-Start (continued)

Step	Procedure	Result	Corrective Action
NOTE If a no-light occurred perform steps 6 through 12, otherwise go to step 13.			
7.	If no engine ignition occurred (Ignition=0), check fuel supply to engine. Motor engine and check for exhaust duct fuel fog.	a. Fuel fogs from exhaust duct. (Motor for 30 seconds after moving PLA to cutoff.)	a. Go to step 8.
		b. No fuel fog.	b. Check following: 1. Throttle rigging. 2. Test cell fuel pump switches ON. 3. Fuel shut-off valve open. 4. Fuel present at MFP inlet. 5. Pfo pressure 10 to 50 psig. 6. Perform engine MFP fuel pressure analysis.
8.	Check ignition system:	a.1. Ignition lights illuminated.	a.1. Go to b.
	a. Ensure test cell ignition switches ON.	a.2. Ignition status light illuminated.	a.2. Press switch to obtain green (ON) status light.
	b. Check P119 for security, contamination, or damage.	b.1. Connector serviceable.	b.1. Go to step 9.
		b.2. Connector loose.	b.2. Connect P119 and repeat start attempt.
		b.3. Connector damaged or contaminated.	b.3. Use specified alcohol or freon degreaser to clean connectors. Replace ignition cable or generator stator.

Table 1. EDU Event Code 1120: Engine No-Start (continued)

Step	Procedure	Result	Corrective Action
9.	Check throttle linkage: a. Ensure MFC PLA linkage secure and rotates smoothly.	a.1. PLA linkage serviceable.	a.1. Go to b.
		a.2. PLA linkage damaged.	a.2. Replace MFC.
	b. Check throttle rigging.	b.1. Rigging within limits.	b.1. Go to step 10.
		b.2. Rigging out of limits.	b.2. Rig throttle.
10.	Check generator main ignition circuits. Perform following resistance checks (See Figure 2): CONN J119 PINS 1. C to D 2. C to GND 3. D to GND 4. G to H 5. G to GND 6. H to GND	a. Resistance checks within limits: 1. LT 10 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 10 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	a. Go to step 11.
		b. Resistance checks out of limits.	b. Replace generator stator.
11.	Check MFC ignition switch. Perform the following resistance checks (See figure 2): CONN J113 PINS (PLA at CUTOFF) 1. A to B 2. A to GND 3. B to GND 4. D to E 5. D to GND 6. E to GND (PLA at IDLE) 7. A to B 8. A to GND 9. B to GND 10. D to E 11. D to GND 12. E to GND	a. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 5 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS 8. GT 100,000 OHMS 9. GT 100,000 OHMS 10. GT 100,000 OHMS 11. GT 100,000 OHMS 12. GT 100,000 OHMS	a. Go to step 12.
		b. Resistance checks out of limits.	b. Replace MFC ignition switch module.

Table 1. EDU Event Code 1120: Engine No-Start (continued)

Step	Procedure	Result	Corrective Action
12.	Perform gas generator ignition system analysis per WP 664 00.	a. Ignition system operates properly. b. Ignition system does not operate properly.	a. Go to step 13. b. Replace ignition components, as required.
13.	Review event and fault data per WP 651 00 or SWP 651 01.	a. Events or faults. b. No events or faults.	a. Troubleshoot individual event or fault codes. b. Go to step 14.
14.	Inspect MFP filter for contamination. Refer to T.O. 2J-F100-53-4, WP 005 00.	a. No contamination. b. Contamination.	a. Go to step 15. b. Troubleshoot fuel system contamination per WP 305 00.
15.	Check RCVV internal rigging. Refer to T.O. 2J-F100-53-4, WP 104 00.	a. RCVV rigging correct. b. RCVV rigging not correct.	a. Go to step 17. b. Go to step 16.
16.	Check RCVV external rigging. Refer to T.O. 2J-F100-53-4, WP 101 00.	a. RCVV rigging correct. b. RCVV rigging not correct.	a. Rig internal RCVV system. Refer to T.O. 2J-F100-53-7, WP 702 00. b. Rig external RCVV system. Refer to T.O. 2J-F100-53-4, WP 101 00.
17.	Borescope rear compressor (AP2, AP3 and AP7). Refer to T.O. 2J-F100-53-5, WP 020 00.	a. Rear compressor within borescope limits. b. Rear compressor out of borescope limits.	a. Go to step 18. b. Repair or replace rear compressor as required.
18.	If not previously accomplished, perform MFP pressure analysis per WP 661 00.	a. Fuel pressures within limits. b. Fuel pressures out of limits.	a. Go to step 19. b. Replace MFP. Refer to T.O. 2J-F100-53-4, WP 005 00.

Table 1. EDU Event Code 1120: Engine No-Start (continued)

Step	Procedure	Result	Corrective Action
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
19.	Check that EDU data has been reviewed and stored; then clear EDU data.		Go to step 20.
20.	Perform start/leak functional check and check engine operation.	a. Engine operates properly. b. Engine does not operate properly.	a. Return engine to service. b. Replace components in following order, if component has not been previously changed, until engine operates properly and repeat steps 19 and 20. • MFC metering valve EHV • MFC

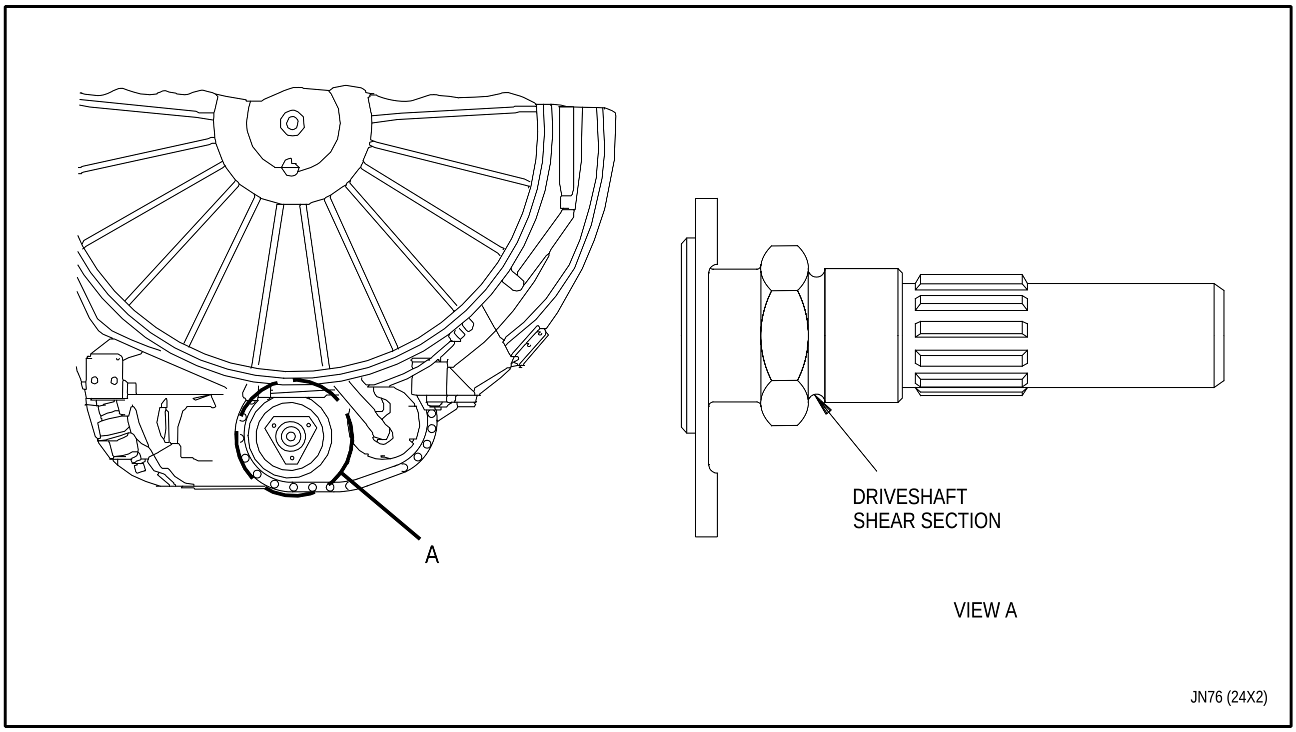
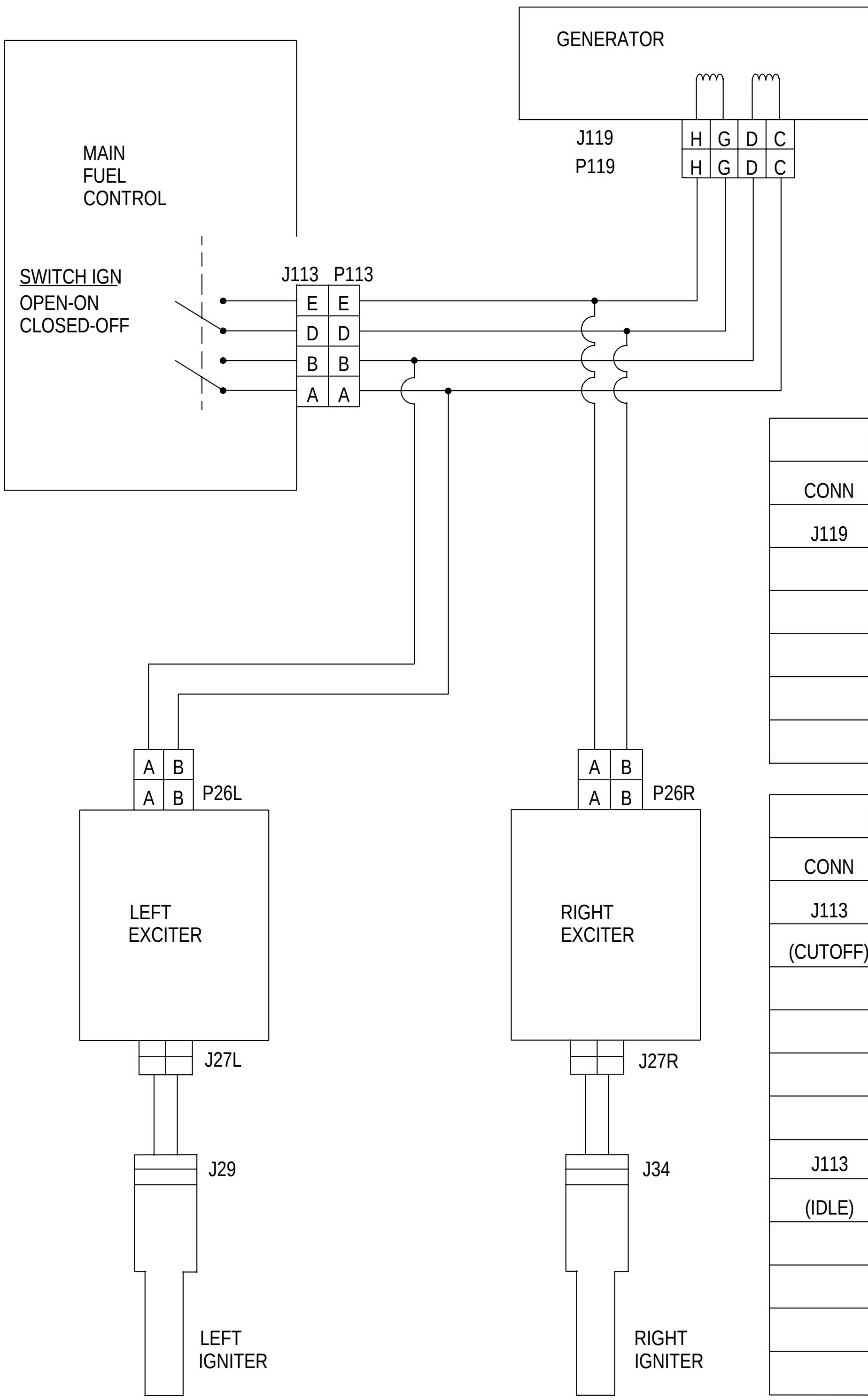


Figure 1. Starter Coupling Jaw - Inspection



RESISTANCE LIMITS		
CONN	PINS	OHMS
J119	C-D	LT 10
	C-GND	GT 100,000
	D-GND	GT 100,000
	G-H	LT 10
	G-GND	GT 100,000
	H-GND	GT 100,000

RESISTANCE LIMITS		
CONN	PINS	OHMS
J113	C-D	LT 5
(CUTOFF)	A-GND	GT 100,000
	B-GND	GT 100,000
	D-E	LT 5
	D-GND	GT 100,000
	E-GND	GT 100,000
J113	A-B	GT 100,000
(IDLE)	A-GND	GT 100,000
	B-GND	GT 100,000
	D-E	GT 100,000
	D-GND	GT 100,000
	E-GND	GT 100,000

JN31X1 (51X2)

Figure 2. Gas Generator/MFC Ignition System Schematic (Resistance Checks)

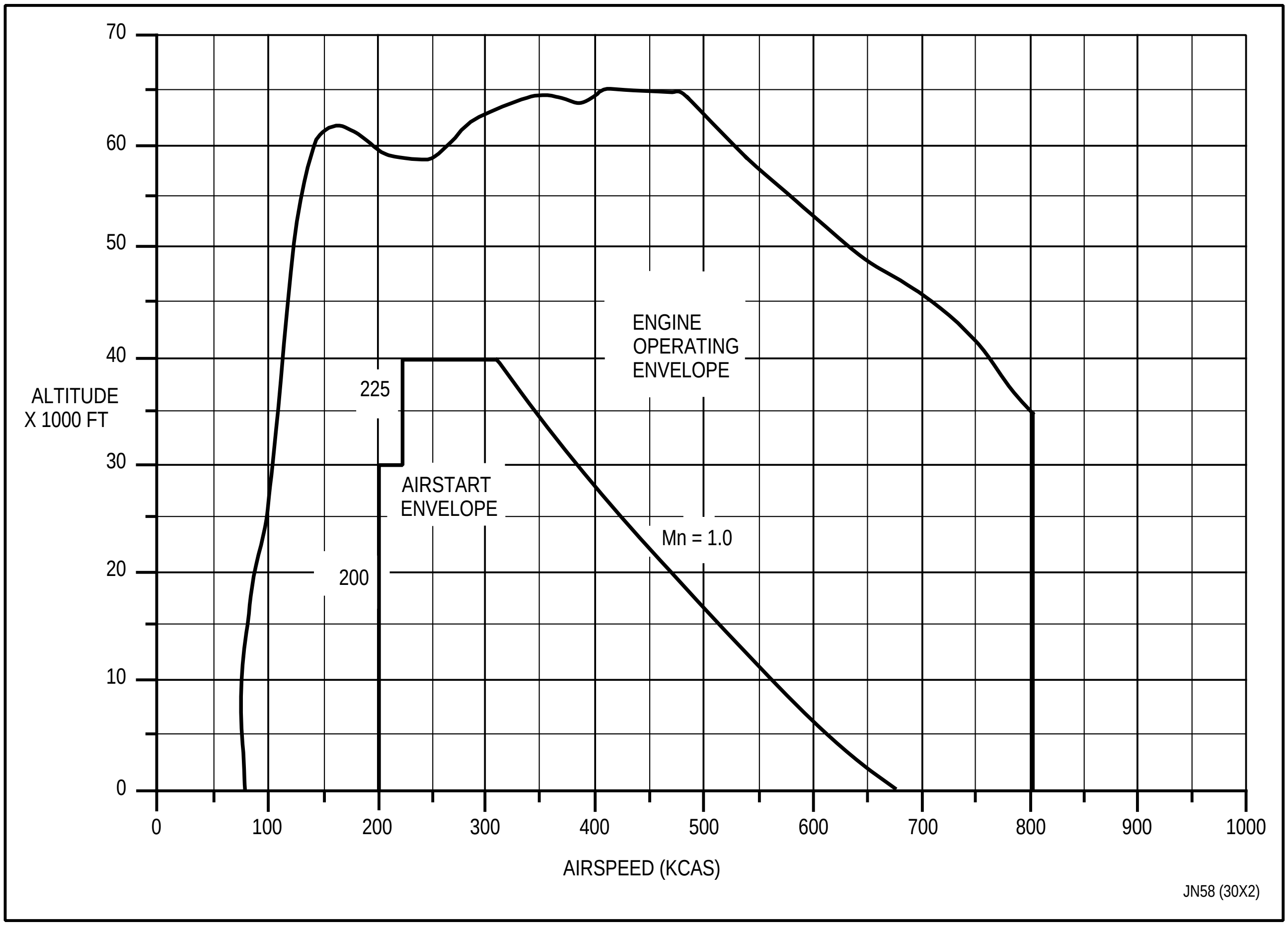


Figure 3. Engine Airstart Envelope - Primary Mode

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1151: RCVV FLUTTER

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
RCVV Position Out of Check Band Limits - Secondary Mode	WP 522 00
Secondary Mode Anomaly	WP 523 00
System Fault Codes 4050 to 4053: RCVV System	WP 606 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for RCVV axial flutter region.

2. EDU EVENT CODE 1151: RCVV AXIAL FLUTTER.

(See Figure 1 and Table 1.)

a. Cause of event:

(1) EDU monitors RCVV position to determine if RCVV has entered axial flutter region. RCVV axial flutter occurs below approximately -4 degrees when N2C2.5 is less than approximately 10,000 rpm. RCVV out of limits in axial flutter region may be caused by control system malfunction. (See figure 1.)

b. Engine Symptoms:

(1) None

c. Data Recorded by EDU:

- Control mode
- Duration
- Mach number
- Altitude
- Rotor speed (N2C2.5)
- RCVV position
- Pt2
- Tt2
- Anti-ice ON or OFF

Table 1. EDU Event Code 1151: RCVV Axial Flutter

Step	Procedure	Result	Corrective Action
1.	Determine status of core module. Compare flutter duration to chart 1.	a. Module serviceable. b. Module not serviceable.	a. Go to step 2. b. Perform corrective action. Go to step 2.

Chart 1. Axial Flutter Corrective Action

Region	Duration	Corrective Action
A and B	0 to 2 seconds More than 2 seconds	Engine serviceable. Troubleshoot cause.

CAUTION

Do not run engine. Severe damage may occur.

Step	Procedure	Result	Corrective Action
2.	2a. Troubleshoot event as directed, but perform only static checks. 2b. Check core module for RCVV axial flutter	a. No corrective action required after static checks b1. No RCVV axial flutter found b2 RCVV axial flutter found	a. Replace DEEC and MFC b1.. Go to step 3. b2. Reject core module
3.	Review event and fault data.	a. Events or faults. b. No events or faults.	a. Troubleshoot individual event of fault codes. b. Go to step 4.
4.	Determine what control mode RCVV axial flutter occurred.	a. In Primary Mode. b. In Secondary Mode.	a. Troubleshoot System Fault Code 4052. b. Troubleshoot Secondary Mode RCVV position out of limits.

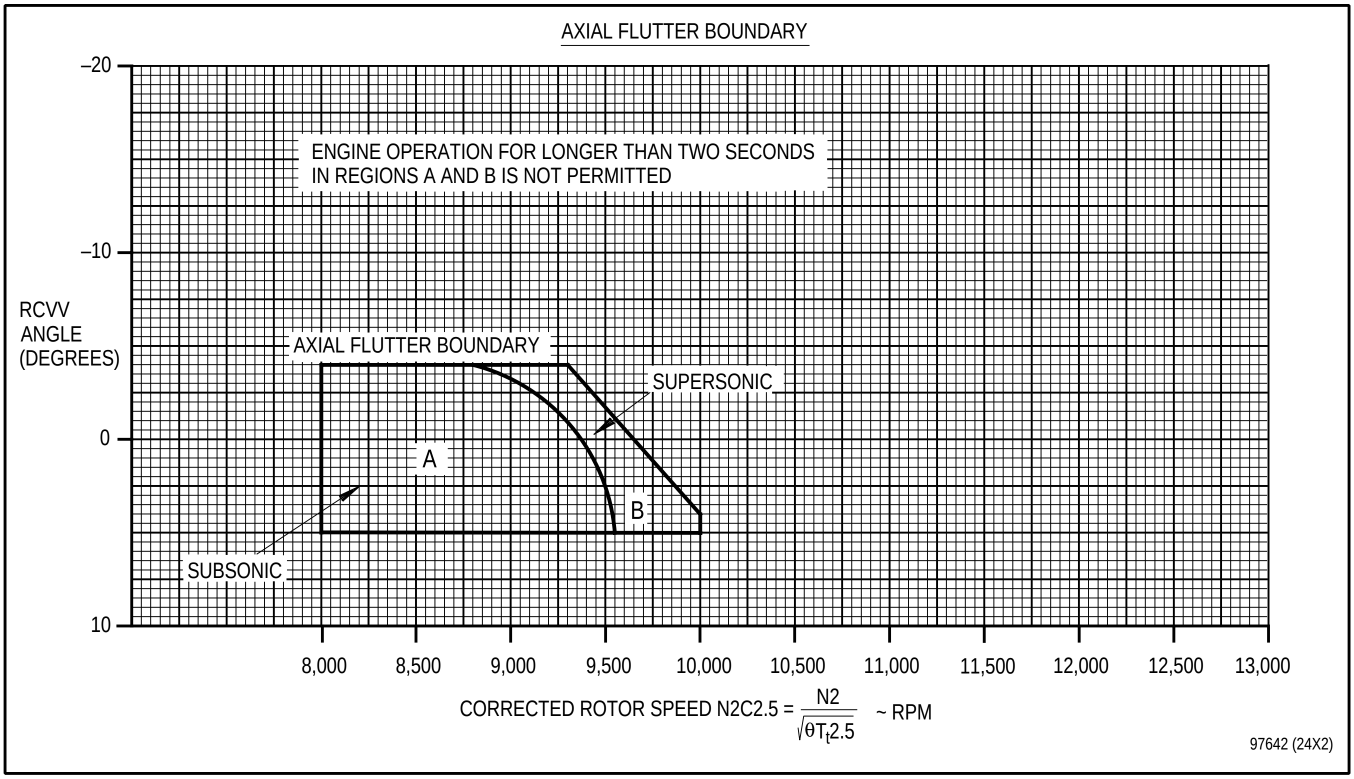


Figure 1. RCVV Axial Flutter Boundary

All data on pages 6 and 7 deleted.

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1152: N2C2.5 HIGH OUT OF LIMITS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	23				

REFERENCE MATERIAL REQUIRED

None

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for N2C2.5 high out of limits.

2. EDU EVENT CODE 1152: N2C2.5 HIGH OUT OF LIMITS.

(See Table 1.)

a. Cause of event:

(1) EDU monitors N2C2.5 as a function of RCVV to determine if limits are exceeded. N2C2.5 high out of limits may indicate a control system malfunction or RCVV mis-rig.

b. Engine Symptoms:

(1) None

c. Data Recorded by EDU:

EMSE DISPLAY	DESCRIPTION
TIME	Time of occurrence
MODE	Control mode at initial indication of high N2C2.5
DURATION	Time spent at high N2C2.5 condition

Table 1. EDU Event Code 1152: N2C2.5 High Out Of Limits

Step	Procedure	Result	Corrective Action
1.	Determine if other faults or events have been detected.	a. Other fault or event codes present.	a. Troubleshoot other codes.
		b. No other faults or events present.	b. Go to step 2.
2.	Determine if high N2C2.5 occurred in PRIMARY or SECONDARY mode.	a. Anomaly occurred in PRIMARY mode.	a. Troubleshoot System Fault Code 4052 per WP 605 00.
		b. Anomaly occurred in SECONDARY mode.	b. Troubleshoot SECONDARY mode anomaly per WP 523 00.

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1170:
START BLEED SYSTEM MALFUNCTION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Acceptance Test	WP 212 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Compressor Bleed System Functional Check	WP 667 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for start bleed system.

2. EDU EVENT CODE 1170: START BLEED SYSTEM.

(See Table 1.)

a. Cause of Event:

(1) A start bleed strap malfunction or start bleed control system malfunction that results in start bleed system not properly closing during engine start. EDU uses N2C2.5 and PT4/Pt2C ratio to detect this condition during engine start. This fault is written when PT4/PT2C ratio does not increase appropriately during start bleed strap closure.

b. Engine Symptoms:

(1) None

c. Data Recorded by EDU:

- N2C2.5 at Time of Event
- PT4/PT2C Pressure Ratio at Time of Event
- PT4/PT2C Correlation Percent Difference from Average at Time of Event

Table 1. EDU Event Code 1170: Start Bleed System

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults.	a. Troubleshoot individual event or fault codes.
		b. No events or faults.	b. Go to step 2.
2.	Perform compressor bleed system functional check. Add per WP 667 00.	a. Start bleed system operates properly.	a. Go to step 3.
		b. Start bleed system does not operate properly.	b. Repair start bleed system.
3.	Check that EDU data has been reviewed and stored per WP 651 00; then clear EDU data per WP 656 00. Go to step 4.		

Table 1. EDU Event Code 1170: Start Bleed System (continued)

Step	Procedure	Result	Corrective Action
4.	Perform IDLE functional check per to WP 216 00. Review EDU data for system fault code per WP 651 00.	a. Event code 1170 does not repeat b. Event code 1170 does repeat.	a. Return engine to service. b. Replace components in the following order one at a time and go to step 5. • MFC start bleed solenoid. Refer to T.O. 2J-F100-53-4, WP 009 00. • Actuator cable. Refer to T.O. 2J-F100-53-4, WP 019 00. • Compressor bleed actuating cylinder. Refer to T.O. 2J-F100-53-4, WP 038 00. • MFC. Refer to T.O. 2J-F100-53-4, WP 009 00. • Start bleed value guide and strap assembly. Refer to T.O. 2J-F100-53-7, WP 014 00.
5.	Clear EDU data per WP 656 00 and return to step 4.		

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1180: ANTI-ICE OVERTEMPERATURE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 4	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Anti-ice System Malfunction	WP 517 00
Engine	T.O. 2J-F100-53-5
Tube, Hose, and Manifold Assemblies, Engine External and Clamps - Inspection and Repair	WP 062 00
Inlet/Fan Module	T.O. 2J-F100-53-6
Case Assembly, Fan Inlet - Inspection	WP 309 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for anti-ice overtemperature.

2. EDU EVENT CODE 1180: ANTI-ICE OVERTEMPERATURE.

(See Tables 1 and 2.)

a. Cause of Event:

(1) Anti-ice temperature exceeded 850°F (454°C) for more than 4 seconds, causing fan inlet case overtemperature.

b. Engine Symptoms:

(1) None

c. Data Recorded by EDU:

(1) Maximum temperature

(2) Total duration of overtemperature

d. Test Cell Observations:

(1) SYSTEM FAULT light on

(2) ENGINE CAUTION light on

(3) ANTI-ICE overtemperature light on

Table 1. EDU Event Code 1180: Anti-Ice Overtemperature

Step	Procedure	Result	Corrective Action
1.	a. Review faults and events. Record temperature and duration of EDU Event Code 1180. Is System Fault Code 4250 present?	a.1. System Fault Code 4250 not present.	a.1. Go to b.
		a.2. System Fault Code 4250 present.	a.2. Troubleshoot anti-ice anomaly, per WP 517 00.
	b. Is System Fault Code 4251 present?	b.1. System Fault Code 4251 not present.	b.1. Go to step 2.
		b.2. System Fault Code 4251 present.	b.2. Troubleshoot anti-ice anomaly, per WP 517 00.
2.	Determine if EDU logic is 2.1.2: EDU Program ID 5-020102 from documentary data or PN 78990H04D04 (4077075D04)	a.1. EDU is 2.1.2	a.1. Troubleshoot anti-ice anomaly per WP 517 00.
		a.2. EDU logic is not 2.1.2.	a.2. Go to step 3.
3.	Use temperature and duration recorded in step 1. to determine corrective action (See table 2).	a. Temperature and duration within limits.	a. Return engine to service.
		b. Temperature and duration out of limits.	b. Repair per table 2.

Table 2. Anti-ice Overtemperature Limits

Duration	Corrective Action Step
0 to 900 seconds (0 to 15 mins.)	Perform Step A
MT 900 seconds (MT 15 mins.)	Perform Steps A,B,C
Anytime temperature is at or above 900°F	Perform Steps A,B,E
Refer to AFTO Form 95, inlet/fan module section, cumulative total of all anti-ice overtemps exceeds 3600 seconds (60 minutes).	Perform Steps A,B,C,D

Step	Corrective Action
A	Record time and maximum temperature for each overtemperature event in AFTO Form 95 for fan module section.
B	Change preformed packings on Ps2 inlet case fittings.
C	Inspect anti-ice plumbing for overtemperature damage.
D	Inspect fan inlet case for damage.
E	Replace anti-ice manifold.

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1190 AND 1191: MAIN OIL PRESSURE INDICATION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 10

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 10	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Acceleration/Deceleration Checks	WP 213 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Engine	T.O. 2J-F100-53-5
Main Gearbox, No. 2 and 3 Bearing Compartment and No. 4 Bearing Compartment - Vacuum Leak Check	WP 429 00
Nozzle, No. 5 Bearing Oil - Airflow Check	WP 431 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for main oil pressure (MOP) indications.

2. EDU EVENT CODE 1190: LOW MOP.

(See Figure 1 and Table 1.)

a. Cause of Event:

(1) Main oil pressure less than 6.0 psid for more than 5 seconds or 60 seconds in flight

b. Engine Symptoms:

(1) None

c. Data Recorded by EDU:

- Minimum MOP
- Duration of low oil pressure
- Time of occurrence
- Anti-ice on or off

Table 1. EDU Event Code 1190: Low MOP

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot individual event or fault codes.
		b. No event or faults present.	b. Go to step 2.
2.	Check oil filter impending bypass indicator for condition.	a. Oil filter impending bypass indicator not tripped.	a. Go to step 3.
		b. Oil filter impending bypass indicator tripped.	b. Remove and inspect oil filter element. Refer to WP 304 00.
3.	Operate engine at Idle.		
	a. Compare MOPT oil pressure value to POPD value.	a.1. MOP vs POPD within limits.	a.1. Go to WP 529 00, step 2.b.
		a.2. MOP vs POPD out of limits.	a.2. Go to step 4.

Table 1. EDU Event Code 1190: Low MOP (continued)

Step	Procedure	Result	Corrective Action
4.	Disconnect J2 connector from EDU. Check test cell power supply to MOPT. See Figure 1.		
	a. CONN P2 PINS 18 to 19	a. Voltmeter checks within limits: 23 to 29 VAC	a. Go to step 5.
		b. Voltmeter checks out of limits.	b. Troubleshoot test cell power supply and cables.
5.	Check MOPT circuit. Perform the following resistance checks. See Figure 1.		
	a. CONN J2 PINS 1. 29 to 30 2. 25 to 26 3. 26 to 27 4. 26 to 27 5. 28 to GND 6. 30 to GND 7. 28 to GND	a.1. Resistance checks within limits: 1. LT 18 OHMS 2. LT 8 OHMS 3. LT 8 OHMS 4. LT 8 OHMS 5. LT 8 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS	a.1. Go to step 6.
		a.2. Resistance checks out of limits.	a.2. Disconnect P51 connector from EDU. Go to step b.
	b. CONN P51 PINS 1. 23 to 24 2. 25 to 26 3. 25 to 27 4. 26 to 27 5. 28 to GND 6. 23 to GND 7. 25 to GND	b.1. Resistance checks within limits: 1. LT 18 OHMS 2. LT 8 OHMS 3. LT 8 OHMS 4. LT 8 OHMS 5. LT 8 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS	b.1. Replace EDU.
		b.2. Resistance checks out of limits.	b.2. Disconnect P8 connector from MOPT. Go to step c.
	c. CONN P8 PINS 1. A to B 2. C to D 3. C to E 4. D to E 5. F to GND 6. A to GND 7. C to GND	c.1. Resistance checks within limits: 1. LT 18 OHMS 2. LT 8 OHMS 3. LT 8 OHMS 4. LT 8 OHMS 5. LT 8 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS	c.1. Replace engine accessories cable.
		c.2. Resistance checks out of limits.	c.2. Replace main oil pressure transmitter.

Table 1. EDU Event Code 1190: Low MOP (continued)

Step	Procedure	Result	Corrective Action
6.	If ENP values are out of limits, check ENPT circuit. Perform the following resistance checks. See Figure 1.		
	a. CONN J2 PINS 1. 18 to 19 2. 21 to 22 3. 21 to 23 4. 22 to 23 5. 20 to GND 6. 18 to GND 7. 21 to GND	a.1. Resistance checks within limits: 1. LT 18 OHMS 2. LT 8 OHMS 3. LT 8 OHMS 4. LT 8 OHMS 5. LT 8 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS	a.1. Go to step 8.
		a.2. Resistance checks out of limits.	a.2. Disconnect P51 from EDU. Go to step b.
	b. CONN P51 PINS 1. 15 to 16 2. 18 to 19 3. 18 to 20 4. 19 to 20 5. 21 to GND 6. 15 to GND 7. 18 to GND	b.1. Resistance checks within limits: 1. LT 18 OHMS 2. LT 8 OHMS 3. LT 8 OHMS 4. LT 8 OHMS 5. LT 8 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS	b.1. Replace EDU.
		b.2. Resistance checks out of limits.	b.2. Disconnect P7 connector from the ENPT on the CENC. Go to step c.
	c. CONN J7 PINS 1. C to F 2. A to B 3. A to D 4. B to D 5. E to GND 6. C to GND 7. A to GND	c.1. Resistance checks within limits: 1. LT 18 OHMS 2. LT 8 OHMS 3. LT 8 OHMS 4. LT 8 OHMS 5. LT 8 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS	c.1. Replace engine accessories cable.
		c.2. Resistance checks out of limits.	c.2. Replace exhaust nozzle position.
7.	deleted		

Table 1. EDU Event Code 1190: Low MOP (continued)

Step	Procedure	Result	Corrective Action
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
8.	Check that EDU data has been reviewed and stored; then clear EDU data.		
9.	Run engine at IDLE with EMSE in auto search mode. Monitor MOP UART word from EDU. Replace the following components in order until engine operates properly:	a. MOP is within range and Event Code 1190 does not repeat.	a. Return engine to service.
	• Main oil pressure transmitter • Accessories cable • Exhaust nozzle position transmitter • EDU	b. MOP remains low or Event Code 1190 repeats.	b. Replace next component and repeat steps 8 and 9.

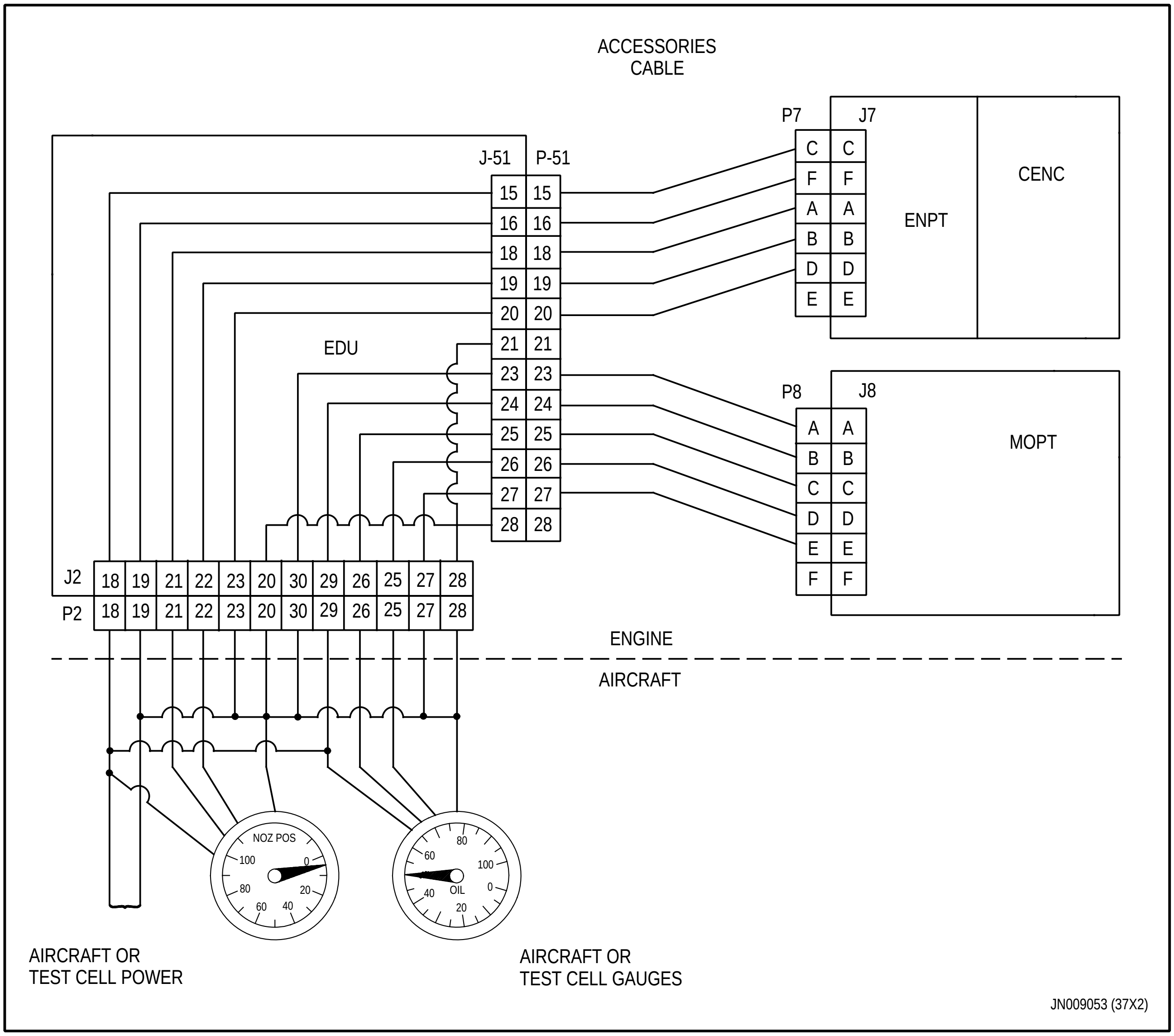


Figure 1. Exhaust Nozzle Position Transmitter (ENPT) and Main Oil Pressure Transmitter (MOPT) Circuit (Sheet 1 of 2)

MOPT RESISTANCE LIMITS			
PINS (J2)	PINS (P51)	PINS (J8)	OHMS
29-30	23-24	A-B	LT 15
25-26	25-26	C-D	LT 5
26-27	25-27	C-E	LT 5
25-27	26-27	D-E	LT 5
28-GND	28-GND	F-GND	LT 5
30-GND	23-GND	A-GND	GT 100,000
26-GND	25-GND	C-GND	GT 100,000
ENPT RESISTANCE LIMITS			
PINS (J2)	PINS (P51)	PINS (J7)	OHMS
18-19	15-16	C-F	LT 15
21-22	18-19	A-B	LT 5
21-23	18-20	A-D	LT 5
22-23	19-20	B-D	LT 5
20-GND	21-GND	E-GND	LT 5
18-GND	15-GND	C-GND	GT 100,000
21-GND	18-GND	A-GND	GT 100,000

JN009054 (24X2)

Figure 1. Exhaust Nozzle Position Transmitter (ENPT) and Main Oil Pressure Transmitter (MOPT) Circuit (Sheet 2 of 2)

3. EDU EVENT CODE 1191: HIGH MOP.

(See Figure 2 and Table 2.)

a. Cause of Event:

(1) Main oil pressure more than 80 psid for more than 15 seconds

b. Engine Symptoms:

(1) None

c. Data Recorded by EDU:

- Maximum MOP
- Duration of high oil pressure
- Time of occurrence
- Anti-ice on or off

Table 2. EDU Event Code 1191: High MOP

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults.	a. Troubleshoot individual event or fault codes.
		b. No events or faults.	b. Go to step 2.
2.	Inspect oil filter element for contamination.	a. No contamination.	a. Replace filter element per T.O. 2J-F100-53-4, WP 030 00.
		b. Contamination.	b. Troubleshoot oil system contamination per WP 304 00.
3.	Operate engine at IDLE. Compare oil pressure transmitter reading to Popd value.	a. MOP vs. Popd within limits.	a. Go to step 4.
		b. MOP vs. Popd out of limits.	b. Replace MOPT.
4.	Inspect last chance oil filters for contamination. (See figure 2).	a. Filters not contaminated.	a. Go to step 5.
		b. Filters contaminated.	b. Troubleshoot oil system for contamination per WP 304 00.
5.	Airflow check number 1, 2-3, 4, and 5 bearing oil jets.	a. Airflows within limits.	a. Go to step 6.
		b. Airflows out of limits.	b. Perform tear down inspection of out-of-limits bearing compartments.
6.	Perform acceleration/ deceleration functional check and check engine MOP. Replace components in following order until engine operates properly:	a. MOP within limits.	a. Return engine to service.
	• Main oil pump • BPV • Gearbox module	b. MOP out of limits.	b. Replace next component and repeat step 6.

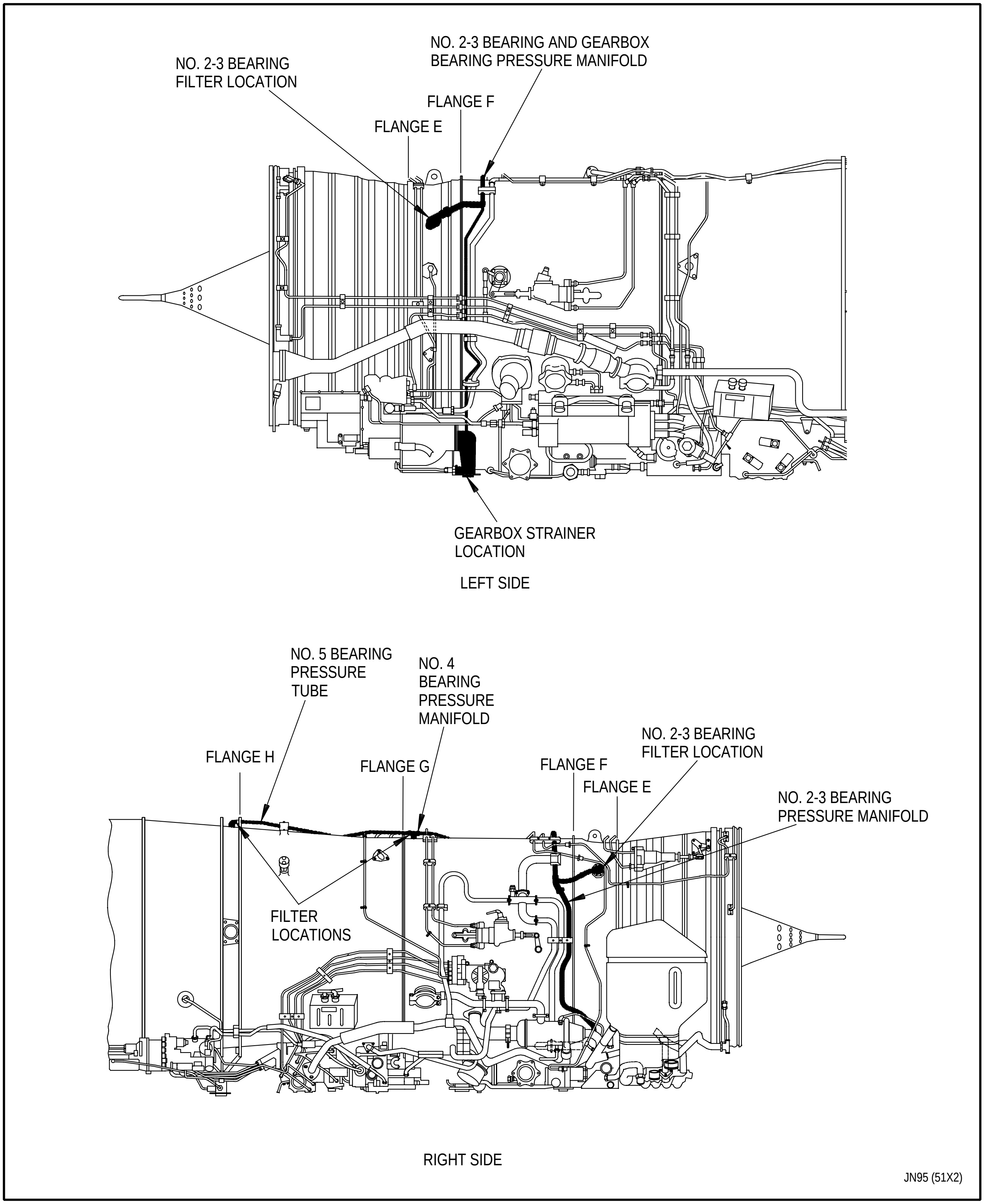


Figure 2. Oil System Last Chance Filters - Locations

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODES 1200 - 1220: PILOT-REPORTED EVENTS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for pilot-reported faults. The following EDU Event Codes provide maintenance personnel with additional information to assist in confirming pilot-reported events.

2. EDU EVENT CODE 1200: AUTO TRANSFER TO SECONDARY MODE.

(See Table 1.)

a. Cause of Fault:

(1) DEEC automatically transferred engine to Secondary Mode due to engine system faults. The following conditions will cause DEEC to transfer to Secondary Mode:

- N1 overspeed detected
- N2 overspeed detected
- FTIT overtemp detected
- N1A and N1B signal loss
- N2A and N2B signal loss
- PLA1 and PLA2 signal loss
- Pb and Ps2 signals out of limits
- DEEC power supply loss
- RCVV EHV malfunction
- Tt2A and Tt2B signal loss
- MFC metering valve EHV malfunction
- Resolver circuit malfunction
- Internal DEEC malfunction.

(2) SECONDARY CAUTION light on when mode select switch shuttled to SECONDARY mode (closed circuit).

b. Engine Symptom:

(1) Transfer to Secondary Mode

c. Test Cell Observations:

(1) ENGINE CAUTION light on

(2) SYSTEM FAULT light on

(3) SECONDARY CAUTION light on

Table 1. EDU Event Code 1200: Auto Transfer to Secondary Mode

Step	Procedure	Result	Corrective Action
1.	Review event and fault data for faults that would cause transfer to Secondary Mode.	a. No events or faults.	a. Return engine to service.
		b. Events or faults.	b. Troubleshoot event or fault codes.

3. EDU EVENT CODE 1210: LOW SCHEDULED THRUST DUE TO FTIT MALFUNCTION.
(See Table 2.)

a. Cause of Fault:

(1) FTIT is calculated using Pb/Pt2, and maximum scheduled N2 is reduced by 1000 rpm. The following conditions will set EDU Event Code 1210:

- FTITA and FTITB out of –65° to 1998°F (–54° to 1092°C) range.
- FTITA and FTITB differ by more than 200°F (111°C).

b. Engine Symptoms:

(1) Reduced thrust

c. Test Cell Observations:

(1) Reduced Intermediate (MIL) thrust parameters

(2) ENGINE CAUTION light on

(3) SYSTEM FAULT light on

Table 2. EDU Event Code 1210: Low Scheduled Thrust - FTIT Malfunction

Step	Procedure	Result	Corrective Action
1.	Review event and fault data for FTIT system malfunctions.	a. No events or faults.	a. Return engine to service.
		b. FTIT events or faults.	b. Troubleshoot FTIT event or fault codes.

4. EDU EVENT CODE 1220: AUGMENTATION INHIBITED.

(See Table 3.)

a. Cause of Fault:

(1) DEEC detected certain engine system faults. Augmentor-associated faults cause DEEC to limit or inhibit augmentation and turn on AUGMENTOR MN FAULT light.

(2) The following conditions will cause DEEC to limit or inhibit augmentation:

- Pb pressure signal out of limits
- Ps2 pressure signal out of limits
- Pt6 pressure signal out of limits
- AFC segment sequencing valve system malfunction
- AFC core metering valve system malfunction
- AFC duct metering valve system malfunction
- CENC system malfunction
- CIVV system malfunction

b. Engine Symptoms:

(1) Augmentation limited or inhibited

c. Test Cell Observations:

(1) Augmentation limited or inhibited

(2) AUGMENTOR MN fault light on

(3) ENGINE CAUTION light on

(4) SYSTEM FAULT light on

Table 3. EDU Event Code 1220: Augmentor Inhibit Fault

Step	Procedure	Result	Corrective Action
1.	Review event and fault data for augmentor inhibit conditions.	a. No events or faults.	a. Return engine to service.
		b. Augmentor inhibit events or faults.	b. Troubleshoot Augmentor inhibit event or fault codes.

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1300:
ENGINE PRESSURE RATIO (EPR) ERROR

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	28	3 - 4	17	6	17
2	18	5	21	7 - 8	28

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Start	WP 210 00
Acceleration/Deceleration Check	WP 213 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
DEEC Pressure Sensing System Analysis	WP 675 00
Engine Accessories and Rigging	T.O. 2J-F100-53-4
Convergent Nozzle Rigging Check	WP 103 00
Inlet/Fan Module	T.O. 2J-F100-53-6
Inlet/Fan module Inspection	WP 300 00
CIVV Rigging Check	WP 705 00
Augmentor Duct and Nozzle Module	T.O. 2J-F100-53-10
Augmentor Duct and Nozzle Module Inspection	WP 300 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for Engine Pressure Ratio (EPR) error event.

2. EDU EVENT CODE 1300: ENGINE PRESSURE RATIO (EPR) ERROR
(See Table 1.)

a. Cause of Fault:

(1) Excessive difference between requested EPR and actual EPR. Error typically results from fan damage, anti-ice valve failed open, pressure sensor failures, or nozzle damage/malfunction. If excessive EPR error is calculated, DEEC accommodates by scheduling a more open nozzle and degrading or inhibiting augmentor operation, to improve stall margin.

b. Engine Symptoms:

(1) Augmentation degraded or inhibited.

(2) F-15: ENGINE CONTROL light on.
F-16: AB inhibit PFL will be indicated.

(3) Nozzle may be observed to be slightly more open than normal during degraded augmentor operation.

c. Test Stand Observation:

(1) AUGMENTOR Mn FAULT light on.

(2) SYSTEM FAULT light on.

d. Date Recorded by EDU.

(1) None.

**Table 1. EDU Event Code 1300:
Engine Pressure Ratio (EPR) Error**

Step	Procedure	Result	Corrective Action
1.	Review event and fault data. Per WP 651 00.	a. Events or faults are present. b. No events or faults are present, other than the 1300 event code.	a. Troubleshoot individual event or fault codes. b. Go to step 2.
2.	Inspect fan inlet for damage, or foreign objects. Visually inspect vanes and blades for damage. Check for disengaged or loose variable vanes. Refer to T.O. 2J-F100-53-6, WP 300 00.	a. DOD/FOD, loose or disengaged variable vanes not found. b. DOD/FOD, loose or disengaged variable vanes found.	a. Go to step 3. b. Repair as required. Go to step 3.
3.	Visually inspect anti-ice valve part number.	a. P/N 4082475 or greater. b. P/N less than 4082475.	a. Go to step 4. b. Replace anti-ice valve. Refer to T.O. 2J-F100-53-4, WP 039 00. Go to step 4.
4.	Inspect augmentor nozzle and exhaust sections for security burning, cracking, or binding. Refer to T.O. 2J-F100-53-10, WP 300 00.	a. Visible damage, binding, or loose components not found. b. Visible damage binding, or loose components found.	a. Go to step 5. b. Repair as required. Go to step 9.
5.	Determine if test stand Pt6 line is connected to engine Pt6 tap.	a. Test stand Pt6 line is not to connected engine. b. Test stand Pt6 line is connected to engine.	a. Go to step 6. b. Disconnect Pt6 line and cap engine Pt6 tap. Go to step 9.
6.	Perform plumbing system integrity check of Ps2 and Pt6 systems per WP 675 00.	a. Plumbing check within limits. b. Plumbing check not within limits.	a. Go to step 7. b. Repair Ps2 and/or Pt6 system. Go to step 9.

**Table 1. EDU Event Code 1300:
Engine Pressure Ratio (EPR) Error (continued)**

Step	Procedure	Result	Corrective Action
7.	Perform CIVV rigging check. Refer to T.O. 2J-F100-53-6, WP 705 00.	a. CIVV rigging is correct. b. CIVV rigging is not correct.	a. Go to step 8. b. Rig CIVV linkage as required. Go to step 9.
8.	Perform nozzle system rig check. Refer to T.O. 2J-F100-53-4, WP 103 00.	a. Rig check within limits. b. Rig check out of limits.	a. Go to step 9. b. Perform corrective action. Go to step 9.

NOTE

Data not cleared from EDU may be interpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
9.	Ensure EDU data has been reviewed and stored per WP 651 00. Clear EDU data per WP 656 00.	a. EDU cleared. b. EDU will not clear.	a. Go to step 10. b. Troubleshoot error message per WP 183 00. Go to step 10.
10.	Perform engine start per WP 210 00. Cycle ENG CONT switch from PRI to SEC and back to PRI. Verify exhaust nozzle operation.	a. Exhaust nozzle operation normal. b. Binding or hesitation present during exhaust nozzle movement.	a. Go to step 11. b. Remove primary flex shafts from exhaust nozzle actuator and CENC. Perform exhaust nozzle functional check. Refer to T.O. 2J-F100-53-10, WP 703 00. Go to step 11.

**Table 1. EDU Event Code 1300:
Engine Pressure Ratio (EPR) Error (continued)**

Step	Procedure	Result	Corrective Action
	WARNING Engine bleed air manifolds and tubing are hot. Touching hot areas while checking for leaks can result in personnel injury.		
11.	With engine at idle, perform leak check of air manifolds: • Anti-ice supply • CENC air supply • 13th stage bleed manifolds • AFP supply • ECS connections	a. No leaks noted. b. Air leaks noted.	a. Go to step 12. b. Repair and replace tubes as required. Go to step 12.
12.	Perform EDU realtime monitor per WP 653 00, monitor TAICE. Run engine at idle for 2 minutes with anti-ice switch OFF. Observe anti-ice temperature (CEDS EDU TAICE). Turn anti-ice switch ON, maintain idle for 1 minute. Turn anti-ice switch OFF.	a. Anti-ice temperature increases, then decreases a minimum of 20°C within 2 minutes after anti-ice switched OFF. b. Anti-ice temperature does not increase when switched ON. c. Anti-ice temperature increases, and does not decrease a minimum of 20°C within 2 minutes after anti-ice switched OFF.	a. Go to step 13. b. Troubleshoot anti-ice system per WP 627 00, 4252 fault. Go to step 14. c. Troubleshoot anti-ice system per WP 627 00, 4251 fault. Go to step 14.

**Table 1. EDU Event Code 1300:
Engine Pressure Ratio (EPR) Error (continued)**

Step	Procedure	Result	Corrective Action
13.	Turn anti-ice switch ON and stablize for 3 minutes at IDLE. Increase PLA (EMSE PLAAB) to 60 degrees PLA. Observe anti-ice temperature (EMSE TAICE).	a. Anti-ice temperature drops at least 20°C (36°F) within 2 minutes.	a. Go to step 14.
		b. Anti-ice temperature does not drop at least 20°C (36°F) within 2 minutes.	b. Troubleshoot per WP 627 00, 4251 fault. Go to step 14.
14.	Perform Ps2 dynamic pressure check per WP 675 00.	a. Analysis passes.	a. Go to step 15.
		b. Analysis fails.	b. Repair or replace components as required. Go to step 15.
15.	Turn anti-ice switch ON. Perform accel/decel functional check per WP 213 00. Perform EDU data review per WP 651 00.	a. Event code 1300 does not repeat.	a. Return engine to service.

Table 2. EDU Event Code 1300:
Engine Pressure Ratio (EPR) Error (continued)

Step	Procedure	Result	Corrective Action
15. cont'd)		b. Event code 1300 repeats.	b. Replace next component, one at a time in the following order, and go to step 16. Refer to T.O. 2J-F100-53-4 for following: • DEEC, WP 007 00 • MFC, WP 009 00 • Anti-ice valve, WP 039 00 • PS2 probe, WP 015 00 • PT6 probe, WP 018 00 • Inlet guide vane case. Refer to T.O. 2J-F100-53-5, WP 111 00 • AFC, WP 010 00
16.	Clear EDU per WP 656 00. Return to step 15.		

WP 576 00 Deleted

WORK PACKAGE

TECHNICAL PROCEDURES

EDU EVENT CODE 1340: N1 SUPPRESSION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	24				
3	17				
4 - 5	24				
6 Blank	17				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Start Procedures	WP 210 00
Acceleration/Deceleration Check	WP 213 00
Compressor Bleed System Functional Check	WP 667 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Thermocouple - Immersion, FTIT Sensing	WP 008 00
Engine	T.O. 2J-F100-53-5
Engine Borescope	WP 020 00
Core Engine Module Installation	WP 218 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for N1 Suppression.

2. EDU EVENT CODE 1340: N1 SUPPRESSION.

(See Table 1.)

a. Cause of Fault:

(1) Engine efficiency is insufficient to provide requested fan speed (N1C2). N1C2 is 800 RPM or more below target level. DEEC accommodates by scheduling a more open nozzle, during augmentor operation, to improve stall margin.

b. Engine Symptoms:

(1) Augmentation degraded.

(2) F-15: ENGINE CONTROL light on.
F-16: AB inhibit PFL and low thrust PFL will be indicated.

(3) Nozzle may be observed to be slightly more open than normal during augmentor operation.

c. Test Stand Observations.

(1) ENGINE CAUTION light on

(2) AUGMENTOR Mn light on

(3) SYSTEM FAULT light on

d. Data recorded by EDU:

(1) None

Table 1. EDU Event Code 1340: N1 Suppression

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults are present. b. No events or faults are present, other than the 1340 event code.	a. Troubleshoot individual event or fault codes. b. Go to step 2.
2.	Ensure 13th stage bleed transfer tubes are installed. Refer to T.O. 2J-F100-53-5, WP 218 00.	a. Transfer tube installed. b. Transfer tube not installed.	a. Go to step 3. b. Install transfer tube. Go to step 6.
3.	Perform compressor bleed system functional check per WP 667 00.	a. No discrepancies noted. b. Discrepancies noted.	a. Go to step 4. b. Perform corrective action as required per WP 607 00. Go to step 6.
4.	Perform engine borescope inspection through AP2, AP3, AP4, and AP6. Refer to T.O. 2J-F100-53-5, WP 020 00.	a. No over limit damage present. b. Over limit damage present.	a. Go to step 5. b. Reject engine for teardown.
5.	Perform FTIT system resistance check. Refer to T.O. 2J-F100-53-4, WP 008 00.	a. System resistance within limits. b. System resistance out of limits.	a. Go to step 6. b. Perform corrective action as required. Refer to T.O. 2J-F100-53-4, WP 008 00. Go to step 6.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
6.	Ensure EDU data has been reviewed and stored; then clear EDU data using EMSE.	a. EDU cleared. b. EDU will not clear.	a. Go to step 7. b. Troubleshoot error message using EMSE. Go to step 7.

Table 1. EDU Event Code 1340: N1 Suppression (continued)

Step	Procedure	Result	Corrective Action

WARNING

Engine bleed air manifolds and tubing are hot. Touching hot areas while checking for leaks can result in personnel injury.

Step	Procedure	Result	Corrective Action
7.	Start engine per WP 210 00. Perform leak check of air manifolds at IDLE: • Anti-ice supply • CENC air supply • 13th stage bleed manifolds • AFP supply • ECS connections	a. No leaks noted. b. Air leaks noted.	a. Go to step 8. b. Repair and replace tubes as required. Go to step 8.
8.	Turn anti-ice switch ON. Perform accel/decel functional check per WP 213 00. Perform EDU data review using EMSE.	a. Event code 1340 does not repeat. b. Event code 1340 repeats.	a. Return engine to service. b. Replace components in following order, one at a time, and go to step 9. • DEEC. Refer to T.O. 2J-F100-53-4, WP 007 00. • FTIT thermocouples. Refer to T.O. 2J-F100-53-4, WP 008 00. • FTIT thermocouple harness. Refer to T.O. 2J-F100-53-4, WP 019 00. • Start bleed valve guide and strap assembly. Refer to T.O. 2J-F100-53-7, WP 014 00. • Core module. Refer to T.O. 2J-F100-53-5, WP 215 00.
9.	Clear EDU using EMSE and return to step 8.		

WORK PACKAGE

TECHNICAL PROCEDURES

DEEC FAULT CODES 2000 - 2999: INTERNAL DEEC MALFUNCTION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	0				
6 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Acceleration/Deceleration Check	WP 213 00
Primary Mode Functional Check	WP 214 00
Engine Troubleshooting - General	WP 501 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Control - Digital Electronic Engine	WP 007 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for internal DEEC malfunctions.

b. System Operation:

(1) Certain tests are provided in DEEC software to check health of DEEC and control system. These tests identify anomalies before they seriously affect engine operation.

(2) Internal fault detected by DEEC self-test.

(a) The Built-In Test (BIT) can be identified as two distinct logic groupings:

1 Initialization BIT

2 BIT during normal engine control

(3) Initial BIT begins after processor is powered for normal operation. These tests include the following items:

(a) RAM check

(b) ROM check

(c) Processor Instruction Check

(d) Timer test

(e) EEPROM Test

(f) N1 Overspeed Test

(g) LOD Test

(h) Parity check test

(4) BIT during normal operation

(a) Torque motor coil integrity tests.

(b) Range checking, (hard and soft) tests for sensors, and actuators.

(c) Test for actuator loop

(d) PROM Checksum, memory parity, processor instructors set and LOD tests.

2. DEEC FAULT CODES 2000 - 2999: INTERNAL DEEC MALFUNCTION.

(See Table 1.)

a. Engine Symptoms:

(1) DEEC accommodates fault

b. Test Cell Observations:

(1) None

(2) Augmentation inhibited

(3) Transfer to Secondary Mode

(4) SYSTEM FAULT light on

Table 1. DEEC Fault Codes 2000 - 2999: Internal DEEC Malfunction

Step	Procedure	Result	Corrective Action
1.	Review event and fault data. Determine if other events or fault codes are present.	a. Other events or fault codes are present.	a. Troubleshoot other events or fault codes, then go to step 2.
		b. No other events or fault codes are present.	b. Go to step 2.
2.	Review engine maintenance records to determine if operator/ pilot reported an anomaly.	a. Operator/pilot did not report an engine anomaly.	a. Go to step 4.
		b. Operator/pilot reported an engine anomaly.	b. Go to step 3.
3.	Determine if engine anomaly was caused by accompanying fault codes and corrected.	a. Cause of anomaly was corrected.	a. Go to step 4
		b. Cause of anomaly was not corrected.	b. Go to step 6.
4.	Review engine maintenance records. Determine if DEEC fault is a repeating fault.	a. DEEC fault repeated.	a. Go to step 6.
		b. DEEC fault not repeated.	b. Go to step 5.

Table 1. DEEC Fault Codes 2000 - 2999: Internal DEEC Malfunction (continued)

Step	Procedure	Result	Corrective Action
	NOTE Fault codes indicated during real-time monitoring may differ from actual fault code condition. To verify fault code condition, download DEEC or EDU faults after engine shutdown.		
5.	For uninstalled engines, perform accel/decel functional check per WP 213 00. Monitor for faults during run using EMSE. For installed engines, perform primary functional check per WP 214 00. Monitor for faults during run using EMSE.	a. DEEC fault present	a. Go to step 6.
		b. DEEC fault not present.	b. Return engine to service.
6.	Record DEEC fault code on AFTO Form 350.		
7.	Replace DEEC. Refer to T.O. 2J-F100-53-4, WP 007 00.		
8.	Purge DEEC of fuel before shipping for repair.		

WORK PACKAGE

TECHNICAL PROCEDURES

EDU FAULT CODES 3000 - 3999: INTERNAL EDU MALFUNCTION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Engine Diagnostic Unit	WP 023 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for internal EDU malfunction.

2. EDU FAULT CODES 3000 - 3999: INTERNAL EDU MALFUNCTION. (See Table 1.)

a. Cause of fault:

(1) Internal fault detected by EDU self-tests

b. Engine Symptoms:

(1) None.

c. Test Cell Observations:

(1) None

(2) SYSTEM FAULT light on

(3) EMS FAULT light on

Table 1. EDU Fault Codes 3000 - 3999: Internal DEEC Malfunction

Step	Procedure	Result	Corrective Action
1.	Determine if there are multiple 3000 series faults.	a. Multiple 3000 series faults occurred	a. Go to step 5.
		b. Only one 3000 series fault exist	b. Go to step 2.
2.	Determine if fault code is 3020.	a. Fault code is 3020	a. Go to step 3.
		b. Fault code is not 3020	b. Go to step 5.
3.	Determine if EDU advanced times and/or cycles from last download.	a. EDU advanced times and/or cycles	a. Go to step 4.
		b. EDU did not advance times or cycles.	b. Go to step 5.
4.	Review engine maintenance records. Determine if fault has repeated three consecutive times.	a. Fault is repeated	a. Go to step 5.
		b. Fault has not repeated	b. Return EDU to service.
5.	Record EDU fault code on AFTO 350 Form.		
6.	Replace EDU. Refer to T.O. 2J-F100-53-4, WP 023 00.		
7.	Purge EDU of fuel prior to shipment for repair.		

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4000 - 4003: CENC SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 16

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Test Requirements	WP 206 00
Idle Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
Engine Accessories and Rigging	T.O. 2J-F100-53-4
Nozzle - Convergent, Actuation System, Integrity Check	WP 040 00
Rigging Check and Rigging Convergent Exhaust Nozzle Control System	WP 103 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4000: CENC Resolver Position Out of Range	
	Ohmmeter	PSM-6 or equivalent
4	System Fault Code 4002: CENC EHV Circuit	
	Ohmmeter	PSM-6 or equivalent
5	System Fault Code 4003: ENP Out Of Range	
	Volt/Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package provides troubleshooting procedures for the Convergent Exhaust Nozzle Control (CENC) system.

b. Refer to T.O. 2J-F100-53-1, WP 011 00 and WP 018 00 for CENC system description and operation.

2. SYSTEM FAULT CODE 4000: CENC RESOLVER POSITION OUT OF RANGE.

(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) CENC resolver out of 94 to 176 resolver-equivalent-degree (RED) range.

b. Engine Symptoms:

(1) Augmentation cancelled

(2) Exhaust nozzle area scheduled to minimum

c. Test Cell Observations:

(1) Augmentation inhibited

(2) ENP does not trim

(3) AUGMENTOR MN FAULT light on

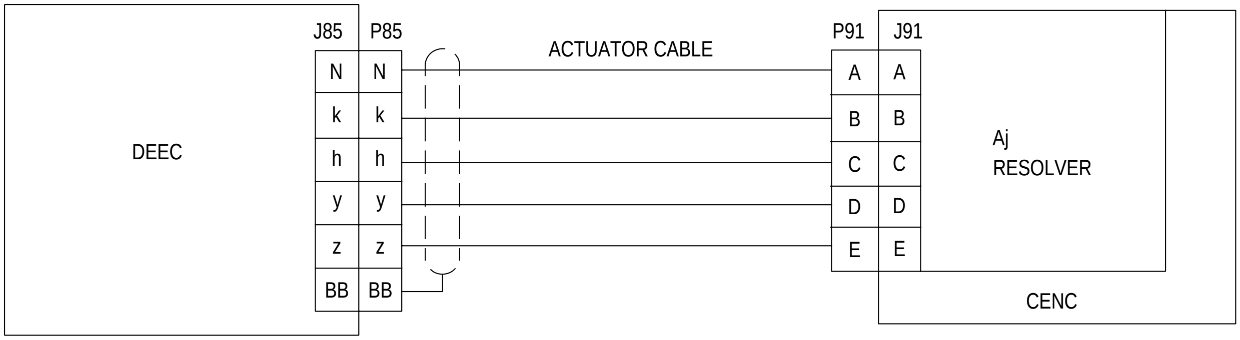
(4) ENGINE CAUTION light on

(5) SYSTEM FAULT light on

(6) EDU Event Code 1220: Augmentation inhibited

Table 1. System Fault Code 4000: CENC Resolver Position Out Of Range

Step	Procedure	Result	Corrective Action
	NOTE If this System Fault Code occurs simultaneous with System Fault Code 4190, troubleshooting of this fault code is unnecessary. (DEEC ID numbers 1-020400, 1-020401 and 1-020402 only.)		
1.	Perform following resistance checks (See figure 1):		
	a. CONN P85 PINS 1. N to BB 2. h to BB	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace actuator cable.
	b. CONN P85 PINS 1. N to k 2. h to y 3. h to z 4. N to h 5. N to GND 6. h to GND	b.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Go to step 3.
		b.2. Resistance checks out of limits.	b.2. Disconnect P91 from CENC. Go to c.
	c. CONN J91 PINS 1. A to B 2. C to D 3. C to E 4. A to C 5. A to GND 6. C to GND	c.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	c.1. Replace actuator cable.
		c.2. Resistance checks out of limits.	c.2. Replace CENC.
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Run engine at IDLE. Check for System Fault Code 4000.Replace components in following order until engine operates properly:	a. System Fault Code 4000 does not repeat.	a. Return engine to service.
	• CENC • DEEC • Actuator cable	b. System Fault Code 4000 repeats.	b. Replace next component and repeat steps 2 and 3.



Aj RESOLVER RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P85	N-k	43-117
	h-y	53-131
	h-z	53-131
	N-h	GT 100,000
	N-GND	GT 100,000
	h-GND	GT 100,000
	N-BB	GT 100,000
	h-BB	GT 100,000

Aj RESOLVER RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
J91	A-B	43-117
	C-D	53-131
	C-E	53-131
	A-C	GT 100,000
	A-GND	GT 100,000
	C-GND	GT 100,000

JN62 (30X2)

Figure 1. CENC Aj Resolver Circuit

3. SYSTEM FAULT CODE 4001: EXHAUST NOZZLE REQUEST OUT OF LIMITS.

(See Figure 2 and Table 2.)

NOTE

If this fault occurs after first start following engine fuel system maintenance, preservation, or initial assembly, no maintenance is required.

a. Cause of Fault:

(1) Difference between actual feedback error and calculated feedback error more than 10 resolver-equivalent degrees.

Actual Error = Aj Request - Aj Resolver Feedback.

Calculated Error = Aj Request - DEEC Expected Aj Resolver Feedback

No other Aj flags set.

b. Engine Symptoms:

(1) Augmentation cancelled

(2) Exhaust nozzle area scheduled to minimum

(3) Increased Intermediate (MIL) thrust

(4) Slow or no nozzle response

c. Test Cell Observations:

(1) Augmentation inhibited

(2) ENP closes

(3) AUGMENTOR MN FAULT light on

(4) SYSTEM FAULT light on

(5) EDU Event Code 1220: Augmentation inhibited

Table 2. System Fault Code 4001: Exhaust Nozzle Request Out Of Limits

Step	Procedure	Result	Corrective Action
1.	Perform Secondary Mode fuel system analysis.	a. System passes analysis.	a. Go to step 2.
		b. System fails analysis.	b. Replace components as required.
NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.			
2.	Check that EDU data has been reviewed and stored per WP 651 00; then clear EDU data per WP 668 00. Go to step 3.		
3.	Perform IDLE functional check per WP 216 00. Review EDU data per WP 651 00.	a. System Fault Code 4001 does not repeat.	a. Return engine to service.
		b. System Fault Code 4001 repeats.	b. Replace next components in the following order: • CENC EHV • CENC • Actuator Electrical Harness • DEEC • MFC

Figure 2. Deleted.

4. SYSTEM FAULT CODE 4002: CENC EHV CIRCUIT.
(See Figure 3 and Table 3.)

a. Cause of Fault:

(1) CENC EHV redundant winding return currents out of limits in current difference check.

(2) CENC open loop failure accompanied by current driver summation check failure.

b. Engine Symptoms:

(1) None

(2) Augmentation cancelled

(3) Exhaust nozzle scheduled to minimum

(4) Increased Intermediate (MIL) thrust

c. Test Cell Observations:

(1) No engine effects

(2) AUGMENTOR MN FAULT light on

(3) Augmentation inhibited

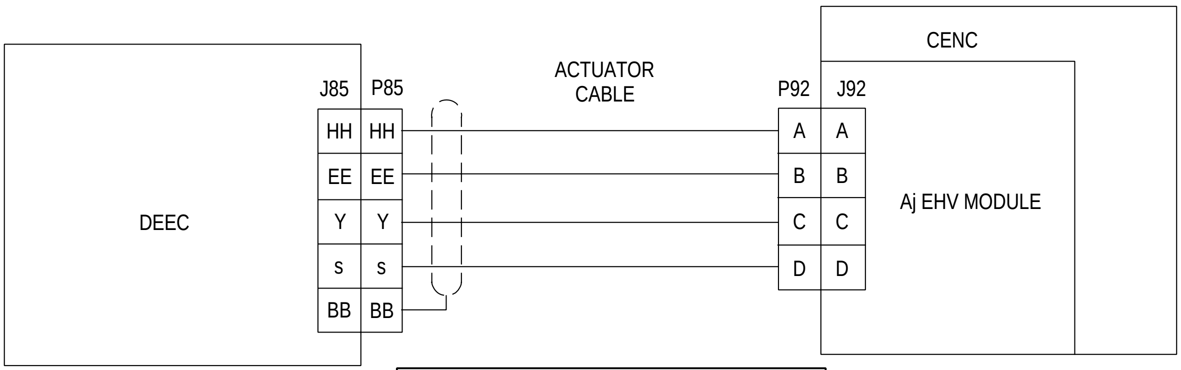
(4) ENP closes

(5) SYSTEM FAULT light on

(6) EDU Event Code 1220: Augmentation inhibited

Table 3. System Fault Code 4002: CENC EHV Circuit

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks (See figure 3):		
	a. CONN P85 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	1. HH to BB	1. GT 100,000 OHMS	
	2. Y to BB	2. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace actuator cable.
	b. CONN P85 PINS	b.1. Resistance checks within limits:	b.1. Go to step 2.
	1. HH to EE	1. 113 to 227 OHMS	
	2. Y to s	2. 113 to 227 OHMS	
	3. HH to Y	3. GT 100,000 OHMS	
	4. HH to GND	4. GT 100,000 OHMS	
	5. Y to GND	5. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Disconnect P92 from CENC. Go to c.
	c. CONN J92 PINS	c.1. Resistance checks within limits:	c.1. Replace actuator cable.
	1. A to B	1. 113-227 OHMS	
	2. C to D	2. 113-227 OHMS	
	3. A to C	3. GT 100,000 OHMS	
	4. A to GND	4. GT 100,000 OHMS	
	5. C to GND	5. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Replace CENC EHV.
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform IDLE functional check. Check for System Fault Code 4002. Replace components in following order until engine operates properly: • CENC EHV • DEEC • CENC cable	a. System Fault Code 4002 does not repeat. b. System Fault Code 4002 repeats.	a. Return engine to service. b. Replace next component and repeat steps 2 and 3.



Aj EHV RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P85	HH-EE	113-227
	Y-s	113-227
	HH-Y	GT 100,000
	HH-GND	GT 100,000
	Y-GND	GT 100,000
	HH-BB	GT 100,000
	Y-BB	GT 100,000

Aj EHV RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
J92	A-B	113-227
	C-D	113-227
	A-C	GT 100,000
	A-GND	GT 100,000
	C-GND	GT 100,000

JN63 (30X2)

Figure 3. CENC Aj EHV Circuit

5. SYSTEM FAULT CODE 4003: EXHAUST NOZZLE POSITION OUT OF RANGE.
(See Figure 4 and Table 4.)

a. Cause of Fault:

(1) CENC signal to EDU from ENPT is out of –3 to 103 percent range.

(2) ENPT malfunction detected.

b. Engine Symptoms:

(1) None

c. Test Cell Observations:

(1) CENC reading erroneous

(2) SYSTEM FAULT light on

Table 4. System Fault Code 4003: Exhaust Nozzle Position Out of Range

Step	Procedure	Result	Corrective Action
1.	Check test cell ENP and oil pressure instrumentation for malfunction.	a. Instrumentation operates properly.	a. Go to step 2.
		b. Instrumentation does not operate properly.	b. Troubleshoot test cell power supply.
2.	Disconnect P2 from EDU. Check test cell power supply to ENPT (See figure 4):		
	CONN PINS	a. Voltmeter check within limits:	a. Go to step 3.
	P2 18 to 19	23 to 29 VAC	
		b. Voltmeter check out of limits.	b. Troubleshoot test cell power supply and cables.
3.	Check ENPT circuit. Disconnect P51 from EDU. Perform following resistance checks (See figure 4):		
	a. CONN P51 PINS 1. 15 to 16 2. 18 to 19 3. 18 to 20 4. 19 to 20 5. 21 to GND 6. 15 to GND 7. 18 to GND	a.1. Resistance checks within limits: 1. LT 25 OHMS 2. LT 15 OHMS 3. LT 15 OHMS 4. LT 15 OHMS 5. LT 5 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS	a.1. Go to step 4.
		a.2. Resistance checks out of limits.	a.2. Disconnect P7 from ENPT on CENC. Go to step b.
	b. CONN J7 PINS 1. C to F 2. A to B 3. A to D 4. B to D 5. E to GND 6. C to GND 7. A to GND	b.1. Resistance checks within limits: 1. LT 25 OHMS 2. LT 15 OHMS 3. LT 15 OHMS 4. LT 15 OHMS 5. LT 5 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS	b.1. Replace engine accessories cable.
		b.2. Resistance checks out of limits.	b.2. Replace ENPT.

Table 4. System Fault Code 4003: Exhaust Nozzle Position Out of Range (continued)

Step	Procedure	Result	Corrective Action
4.	Check MOPT circuit. Perform following resistance checks, (See figure 4).		
	a. CONN P51 PINS	a.1. Resistance checks within limits:	a.1. Go to step 5.
	1. 23 to 24	1. LT 18 OHMS	
	2. 25 to 26	2. LT 8 OHMS	
	3. 25 to 27	3. LT 8 OHMS	
	4. 26 to 27	4. LT 8 OHMS	
	5. 28 to GND	5. LT 8 OHMS	
	6. 23 to GND	6. GT 100,000 OHMS	
	7. 25 to GND	7. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Disconnect P8 from MOPT. Go to b.
	b. CONN J8 PINS	b.1. Resistance checks within limits:	b.1. Replace engine accessories cable.
	1. A to B	1. LT 18 OHMS	
	2. C to D	2. LT 8 OHMS	
	3. C to E	3. LT 8 OHMS	
	4. D to E	4. LT 8 OHMS	
	5. F to GND	5. LT 8 OHMS	
	6. A to GND	6. GT 100,000 OHMS	
	7. C to GND	7. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Replace MOPT.
5.	Remove one primary (output) driveshaft from CENC. Rotate open output shaft drive until CENC rig counter indicates 500. Remove ENPT rigging indicator and check pointer location.	a. ENPT out of rig.	a. Rig ENPT.
		b. ENPT rigged properly.	b. Go to step 6.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
6.	Check that EDU data has been reviewed and stored; then clear EDU data.		

Table 4. System Fault Code 4003: Exhaust Nozzle Position Out of Range (continued)

Step	Procedure	Result	Corrective Action
7.	Perform IDLE functional check. Check for System Fault Code 4003.	a. System Fault Code 4003 does not repeat.	a. Return engine to service.
		b. System Fault Code 4003 repeats.	b. Replace next component in following order (ENPT, MOPT, EDU, Accessories cable). Repeat steps 6 and 7.

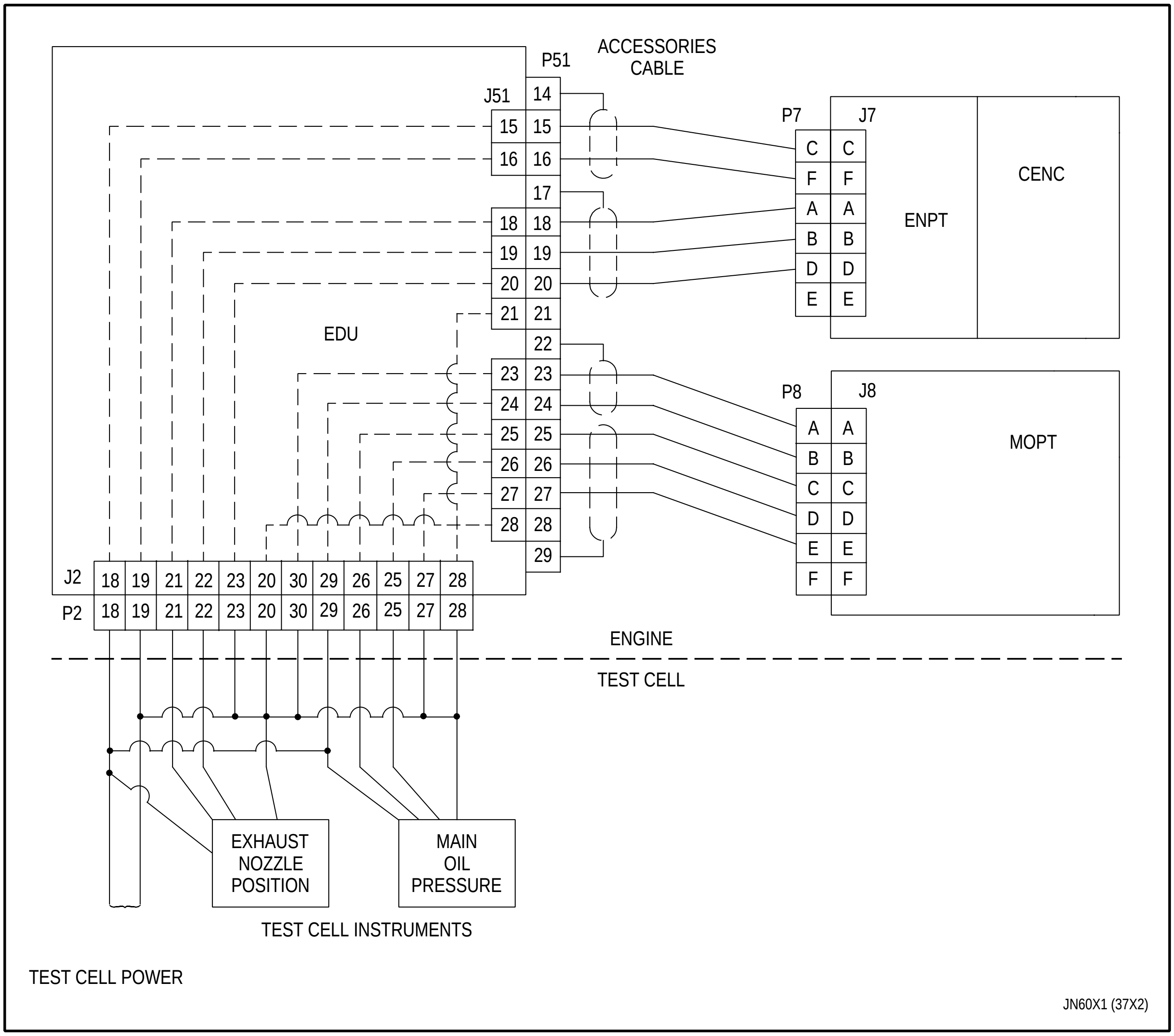


Figure 4. ENPT and MOPT Circuit (Sheet 1 of 2)

MOPT RESISTANCE LIMITS		
PINS (P51)	PINS (J8)	OHMS
23–24	A–B	LT 18
25–26	C–D	LT 8
25–27	C–E	LT 8
26–27	D–E	LT 8
28–GND	F–GND	LT 8
23–GND	A–GND	GT 100,000
25–GND	C–GND	GT 100,000
22–23		GT 100,000
22–24		GT 100,000
25–29		GT 100,000
26–29		GT 100,000
27–29		GT 100,000
ENPT RESISTANCE LIMITS		
PINS (P51)	PINS (J7)	OHMS
15–16	C–F	LT 25
18–19	A–B	LT 15
18–20	A–D	LT 15
19–20	B–D	LT 15
21–GND	E–GND	LT 5
15–GND	C–GND	GT 100,000
18–GND	A–GND	GT 100,000
14–15		GT 100,000
14–16		GT 100,000
17–18		GT 100,000
17–19		GT 100,000
17–20		GT 100,000

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Figure 4. ENPT and MOPT Circuit (Sheet 2 of 2)

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4010 - 4013: CIVV SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 14

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	18				
3 - 8	0				
9	2				
10	0				
11 - 12	17				
13 - 14 Added	17				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Test Requirements	WP 206 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
Secondary Mode Fuel System Analysis	WP 663 00
Engine Accessories and Rigging	T.O. 2J-F100-53-4
Cylinder-Actuating, Linear, Variable Vane,Compressor Inlet	WP 037 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	SYSTEM FAULT CODE 4010: CIVV RESOLVER POSITION OUT OF RANGE	
	OHMMETER	PSM-6 OR EQUIVALENT
4	SYSTEM FAULT CODE 4012: CIVV EHV AND AFC SEQUENCING VALVE POSITION CIRCUIT MALFUNCTION	
	OHMMETER	PSM-6 OR EQUIVALENT

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for CIVV system.

2. SYSTEM FAULT CODE 4010: CIVV RESOLVER POSITION OUT OF RANGE.
(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) CIVV resolver out of 94 to 176 resolver-equivalent-degree (RED) range.

b. Engine Symptoms:

(1) CIVVs retract

(2) CENC trim inhibited

(3) Augmentation inhibited

c. Test Cell Observations:

(1) Augmentation inhibited

(2) AUGMENTOR MN FAULT light on

(3) ENGINE CAUTION light on

(4) SYSTEM FAULT light on

(5) EDU Event Code 1220: Augmentation inhibited

Table 1. System Fault Code 4010: CIVV Resolver Position Out Of Range

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks (See figure 1):		
	a. CONN P85 PINS 1. L to BB 2. K to BB	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace actuator cable.
	b. CONN P85 PINS 1. L to M 2. K to f 3. K to g 4. L to K 5. L to GND 6. K to GND	b.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Disconnect P93 from CIVV control and cylinder. Go to d.
	c. CONN J93 PINS 1. A to B 2. C to D 3. C to E 4. A to C 5. A to GND 6. C to GND	c.1. Resistance checks are within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	c.1 Replace actuator cable.
		c.2. Resistance checks out of limits.	c.2. Replace CIVV control and cylinder.

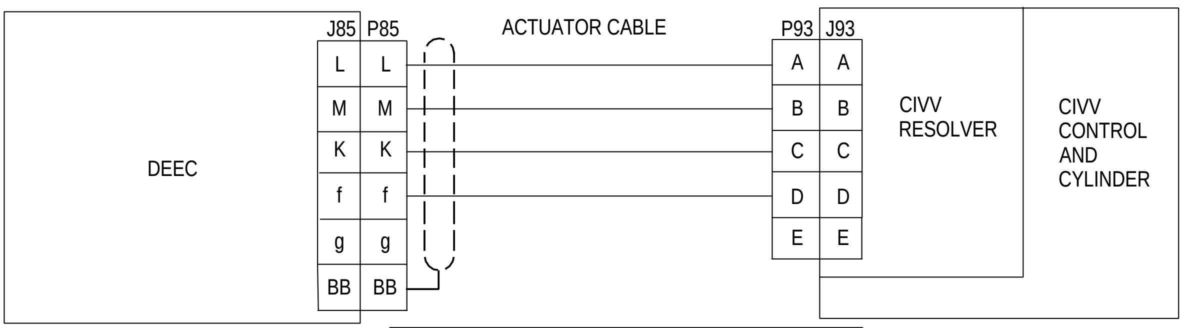
NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		

Table 1. System Fault Code 4010: CIVV Resolver Position Out Of Range (continued)

Step	Procedure	Result	Corrective Action
3.	Perform IDLE functional check. Check for System Fault Code 4010. Replace components in following order until engine operates properly: • CIVV control and cylinder • DEEC • Actuator cable	a. System Fault Code 4010 does not repeat. b. System Fault Code 4010 repeats.	a. Return engine to service. b. Replace next component. Repeat steps 2 and 3.



CIVV RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P85	L-M	43-117
	K-f	53-131
	K-g	53-131
	L-K	GT 100,000
	L-GND	GT 100,000
	K-GND	GT 100,000
	L-BB	GT 100,000
	K-BB	GT 100,000

CIVV RESOLVER RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
J93	A-B	43-117
	C-D	53-131
	C-E	53-131
	A-C	GT 100,000
	A-GND	GT 100,000
	C-GND	GT 100,000

JN64 (30X2)

Figure 1. CIVV Resolver Circuit

3. SYSTEM FAULT CODE 4011: CIVV POSITION OUT OF LIMITS.
(See Table 2.)

NOTE

If this fault occurs after first start following engine fuel system maintenance, preservation, or initial assembly, no maintenance is required.

a. Cause of Fault:

(1) Difference between actual feedback error and calculated feedback error exceeds 10 resolver-equivalent degrees (RED):

Actual Error = CIVV Request - CIVV Resolver Feedback.

Calculated Error = CIVV Request - DEEC Expected CIVV Feedback.

No other CIVV flags set.

b. Engine Symptoms:

(1) CIVVs retract

(2) Augmentation inhibited

(3) CENC trim inhibited

c. Test Cell Observations:

(1) Augmentation inhibited

(2) AUGMENTOR MN FAULT light on

(3) ENGINE CAUTION light on

(4) SYSTEM FAULT light on

(5) EDU Event Code 1220: Augmentation inhibited

Table 2. System Fault Code 4011: CIVV Position Out Of Limits

Step	Procedure	Result	Corrective Action
	NOTE If this System Fault Code occurs simultaneous with Systems Fault Code 4190, troubleshooting of this fault code is unnecessary. (DEEC ID numbers 1-020400, 1-020401, and 1-020402 only).		
1.	Perform CIVV functional check.	a. CIVV actuation system out of limits.	a. Repair or replace CIVV actuation system parts as required.
		b. CIVV actuation system within limits.	b. Go to step 2.
2.	Perform Secondary Mode fuel system analysis.	a. System fails analysis.	a. Replace parts as required.
		b. System passes analysis.	b. Go to step 3.
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
3.	Check that EDU data has been reviewed and stored; then clear EDU data.		
4.	Operate engine at Intermediate (MIL). Check for System Fault Code 4011. Replace components in following order until engine operates properly: • CIVV EHV • CIVV control and cylinder • DEEC • Actuator cable.	a. System Fault Code 4011 does not repeat. b. System Fault Code 4011 repeats.	a. Return engine to service. b. Replace next component. Repeat steps 3 and 4.

4. SYSTEM FAULT CODE 4012: CIVV EHV AND AFC SEQUENCING VALVE POSITION CIRCUIT MALFUNCTION.

(See Figure 2 and Table 3.)

a. Cause of Fault:

NOTE

Malfunction of one EHV winding may trip flag with no effect on engine operation.

(1) CIVV EHV and SVP EHV redundant winding return currents disagree during check of redundant winding circuits.

(2) CIVV open loop failure accompanied by current driver summation check failure.

b. Engine Symptoms:

(1) None
(or)

(2) CIVVs go full cambered

(3) Augmentation inhibited

(4) CENC trim inhibited

(5) May observe lower than normal N_2 and FTIT at Intermediate (MIL) power

c. Test Cell Observations:

(1) SYSTEM FAULT light on

(2) No engine effect for single EHV winding malfunction
(or)

(3) Augmentation inhibited

(4) AUGMENTOR MN FAULT light on

(5) ENGINE CAUTION light on

(6) SYSTEM FAULT light on

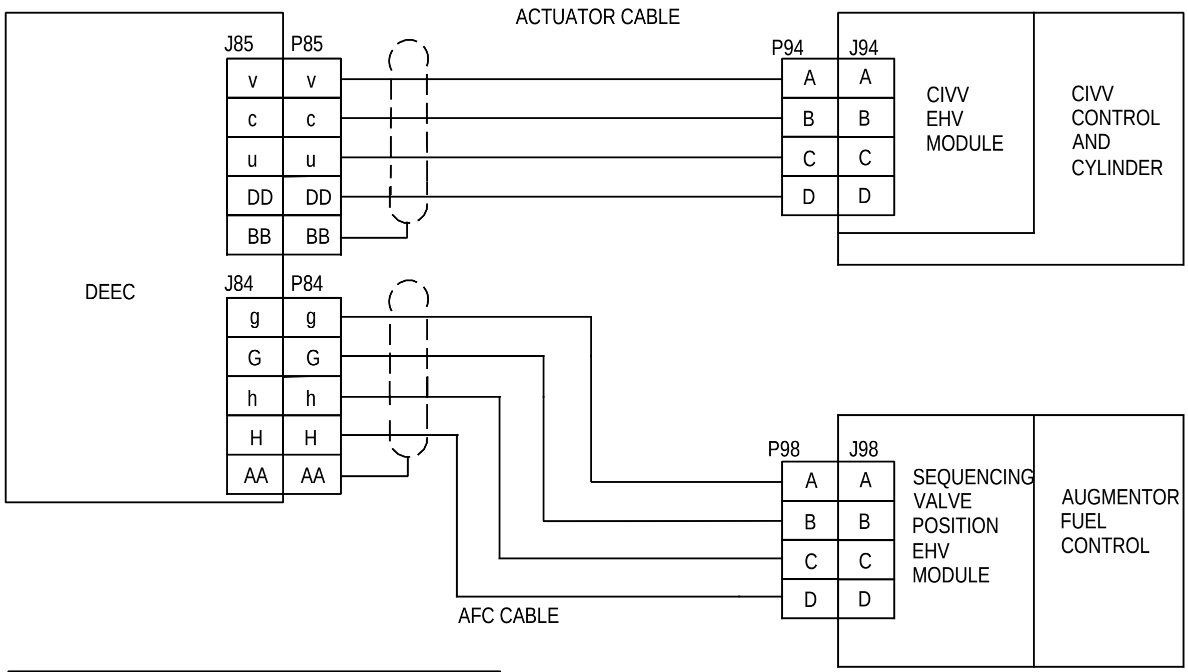
(7) EDU Event Code 1220: Augmentation inhibited

Table 3. System Fault Code 4012: CIVV and AFC SVP EHV Circuit Malfunction

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks (See figure 2):		
	a. CONN P85 PINS 1. v to BB 2. u to BB	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace actuator cable.
	b. CONN P85 PINS 1. v to c 2. u to DD 3. v to u 4. v to GND 5. u to GND	b.1. Resistance checks within limits: 1. 113 to 227 OHMS 2. 113 to 227 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Remove P94 from CIVV control and cylinder. Go to c.
	c. CONN J94 PINS 1. A to B 2. C to D 3. A to C 4. A to GND 5. C to GND	c.1. Resistance checks within limits: 1. 113 to 227 OHMS 2. 113 to 227 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	c.1. Replace actuator cable.
		c.2. Resistance checks are out of limits.	c.2. Replace CIVV control and cylinder EHV.
2.	Perform following resistance checks (See figure 2):		
	a. CONN P84 PINS 1. h to AA 2. g to AA	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace augmentor fuel control cable.

Table 3. System Fault Code 4012: CIVV and AFC SVP EHV Circuit Malfunction (continued)

Step	Procedure	Result	Corrective Action
2. (cont'd)	b. CONN P84 PINS (AFC SVP) 1. g to G 2. h to H 3. g to h 4. h to GND 5. g to GND	b.1. Resistance checks within limits: 1. 113 to 227 OHMS 2. 113 to 227 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	b.1. Go to step 3.
		b.2. Resistance checks out of limits.	b.2. Disconnect P98 connector from AFC EHV modules as required. Go to c.
	c. CONN J98 PINS (AFC SVP) 1. A to B 2. C to D 3. A to C 4. A to GND 5. C to GND	c.1. Resistance checks within limits: 1. 113 to 227 OHMS 2. 113 to 227 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	c.1. Replace AFC cable.
		c.2. Resistance checks out of limits.	c.2. Replace AFC sequential valve position EHV modules.
NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.			
3.	Check that EDU data has been reviewed and stored; then clear EDU data.		
4.	Perform IDLE function check. Check for System Fault Code 4012. Replace components in following order, if component has not been previously changed, until engine operates properly: • CIVV EHV • AFC SVP EHV • DEEC • Actuator cable • AFC cable	a. System Fault Code 4012 does not repeat. b. System Fault Code 4012 repeats.	a. Return engine to service. b. Replace next component and repeat steps 3 and 4.



CIVV EHV RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P85	v–c	113–227
	u–DD	113–227
	v–u	GT 100,000
	v–GND	GT 100,000
	u–GND	GT 100,000
	v–BB	GT 100,000
	u–BB	GT 100,000

CIVV EHV RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
J94	A–B	113–227
	C–D	113–227
	A–C	GT 100,000
	A–GND	GT 100,000
	C–GND	GT 100,000

SEQUENCING VALVE POSITION EHV RESISTANCE LIMITS		
PINS (P84)	PINS (J98)	OHMS
g–G	A–B	113–227
h–H	C–D	113–227
g–h	A–C	GT 100,000
g–GND	A–GND	GT 100,000
h–GND	C–GND	GT 100,000
g–AA		GT 100,000
h–AA		GT 100,000

JN008341 (36X2)

Figure 2. CIVV and SVP EHV Circuits

5. SYSTEM FAULT CODE 4013: CIVV EHV CIRCUIT MALFUNCTION.

(See figure 2 and Table 4.)

a. Cause of Fault:

(1) CIVV current driver summation check failure.

b. Engine Symptoms:

(1) No Engine Effect
(or)

(2) CIVVs go full cambered and Augmentation Inhibited

c. Test Cell Observation:

(1) SYSTEM FAULT light on
(or)

(2) AUGMENTOR Mn FAULT light, ENGINE CAUTION light, and SYSTEM FAULT lights on

Table 4. System Fault Code 4013: CIVV EHV Circuit Malfunction

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks per figure 2:		
	a. CONN P85 PINS	a.1. Resistance checks within limits:	a.1. Go to step 2.
	1. v to c	1. 113 to 227 OHMS	
	2. u to DD	2. 113 to 227 OHMS	
	3. v to u	3. GT 100,000 OHMS	
	4. v to GND	4. GT 100,000 OHMS	
	5. u to GND	5. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Go to step b.
	b. CONN J94 PINS	b.1. Resistance checks within limits:	b.1. Replace actuator cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 2.
	1. A to B	1. 113 to 227 OHMS	
	2. C to D	2. 113 to 227 OHMS	
	3. A to C	3. GT 100,000 OHMS	
	4. A to GND	4. GT 100,000 OHMS	
	5. C to GND	5. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Replace CIVV control EHV. Refer to T.O. 2J-F100-53-4, WP 036 00. Go to step 2.

Table 4. System Fault Code 4013: CIVV EHV Circuit Malfunction (continued)

Step	Procedure	Result	Corrective Action
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
2.	Check that EDU data has been reviewed and stored per WP 651 00; then clear EDU data per WP 656 00. Go to step 3.		
3.	Perform IDLE functional check per WP 216 00. Review EDU data for system fault code per WP 651 00.	a. Fault code 4013 does not repeat. b. Fault code 4013 repeats.	a. Return engine to service. b. Replace components in following order one at a time and go to step 4.: • CIVV EHV. Refer to T.O. 2J-F100-53-4, WP 036 00. • DEEC. Refer to T.O. 2J-F100-53-4, WP 007 00. • Actuator cable. Refer to T.O. 2J-F100-53-4, WP 019 00.
4.	Clear EDU data per WP 656 00 and return to step 3.		

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4020 - 4022: SEQUENCING VALVE POSITION SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	2				
2 - 9	0				
10 - 11	2				
12 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Test Requirements	WP 206 00
Acceleration/Deceleration Checks	WP 213 00
Idle Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
Secondary Mode Fuel System Analysis	WP 663 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4020: AFC Segment Sequencing Valve Resolver Position Out of Range	
	Ohmmeter	PSM-6 or equivalent
4	System Fault Code 4022: AFC Segment Sequencing Valve EHV Circuit	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for sequencing valve position (SVP) system.

2. SYSTEM FAULT CODE 4020: AFC SEGMENT SVP OUT OF RANGE.
(See Figure 1, and Table 1.)

a. Cause of Fault:

(1) AFC segment sequencing valve resolver out of 92 to 178 resolver-equivalent degree (RED) range.

b. Engine Symptoms:

(1) Augmentation inhibited

c. Test Cell Observations:

(1) Augmentation inhibited

(2) AUGMENTOR MN FAULT light on

(3) ENGINE CAUTION light on

(4) SYSTEM FAULT light on

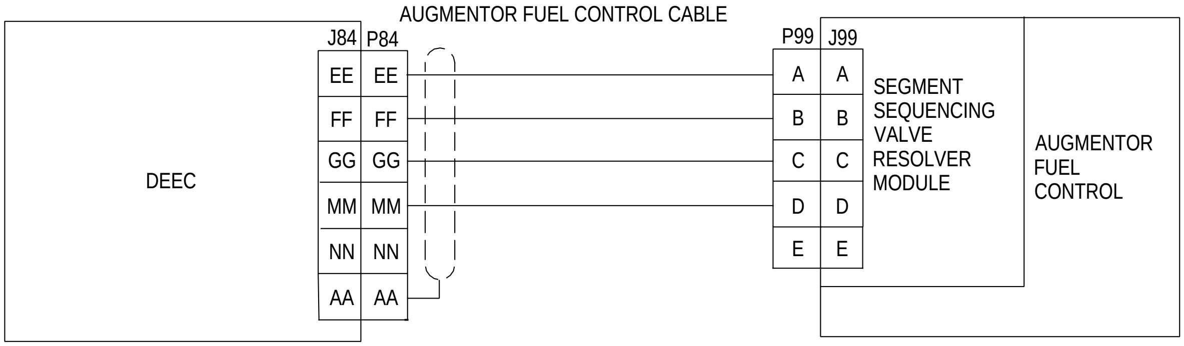
(5) EDU Event Code 1220: Augmentation inhibited

Table 1. System Fault Code 4020: AFC Segment SVP Out Of Range

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks (See figure 1):		
	a. CONN P84 PINS 1. EE to AA 2. GG to AA	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace AFC cable.
	b. CONN P84 PINS 1. EE to FF 2. GG to MM 3. GG to NN 4. EE to GG 5. EE to GND 6. GG to GND	b.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Disconnect P99 from AFC segment sequencing valve resolver module. Go to c.
	c. CONN J99 PINS 1. A to B 2. C to D 3. C to E 4. A to C 5. A to GND 6. C to GND	c.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	c.1. Replace AFC cable.
		c.2. Resistance checks out of limits.	c.2. Replace AFC segment sequencing valve resolver.

Table 1. System Fault Code 4020: AFC Segment SVP Out Of Range (continued)

Step	Procedure	Result	Corrective Action
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform IDLE functional check. Check for System Fault Code 4020. Replace components in following order until engine operates properly: • AFC segment sequencing valve resolver module • DEEC • AFC • AFC cable	a. System Fault Code 4020 does not repeat. b. System Fault Code repeats.	a. Return engine to service. b. Replace next component and repeat steps 2 and 3.



SVP RESOLVER RESISTANCE LIMITS		
PINS (P84)	PINS (J99)	OHMS
EE-FF	A-B	43-117
GG-MM	C-D	53-131
GG-NN	C-E	53-131
EE-GG	A-C	GT 100,000
EE-GND	A-GND	GT 100,000
GG-GND	C-GND	GT 100,000
EE-AA		GT 100,000
GG-AA		GT 100,000

Figure 1. AFC Segment Sequencing Valve Resolver Circuit

3. SYSTEM FAULT CODE 4021: AFC SEGMENT SVP OUT OF LIMITS.
(See Figure 2 and Table 2.)

NOTE

If this fault occurs after first start following engine fuel system maintenance, preservation, or initial assembly, no maintenance is required.

a. Cause of Fault:

(1) Difference between actual feedback error and calculated feedback error exceeds five resolver-equivalent degrees (RED):

Actual Error = SVP Request - SVP Resolver Feedback.

Calculated Error = SVP Request - DEEC Expected SVP Feedback.

No other SVP flags set.

b. Engine Symptoms:

(1) Augmentation inhibited

c. Test Cell Observations:

(1) Augmentation inhibited

(2) AUGMENTOR MN FAULT light on

(3) ENGINE CAUTION light on

(4) SYSTEM FAULT light on

(5) EDU Event Code 1220: Augmentation inhibited

**Table 2. System Fault Code 4021:
AFC Segment SVP Out Of Limits**

Step	Procedure	Result	Corrective Action
NOTE If this System Fault Code occurs simultaneous with System Fault Code 4190, troubleshooting of this fault code is unnecessary. (DEEC ID numbers 1-020400, 1-020401 and 1-020402 only.)			
1.	Perform Secondary Mode fuel system analysis.	a. System passes analysis.	a. Go to step 2.
		b. System fails analysis.	b. Replace components as required.
NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.			
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform acceleration/ deceleration functional check. Check for System Fault Code 4021. Replace components in following order until engine operates properly: • AFC segment sequencing valve EHV module • AFC segment sequencing valve resolver module • DEEC • AFC • AFC cable	a. System Fault Code 4021 does not repeat.	a. Return engine to service.
		b. System Fault Code 4021 repeats.	b. Replace next component. Repeat steps 2 and 3.

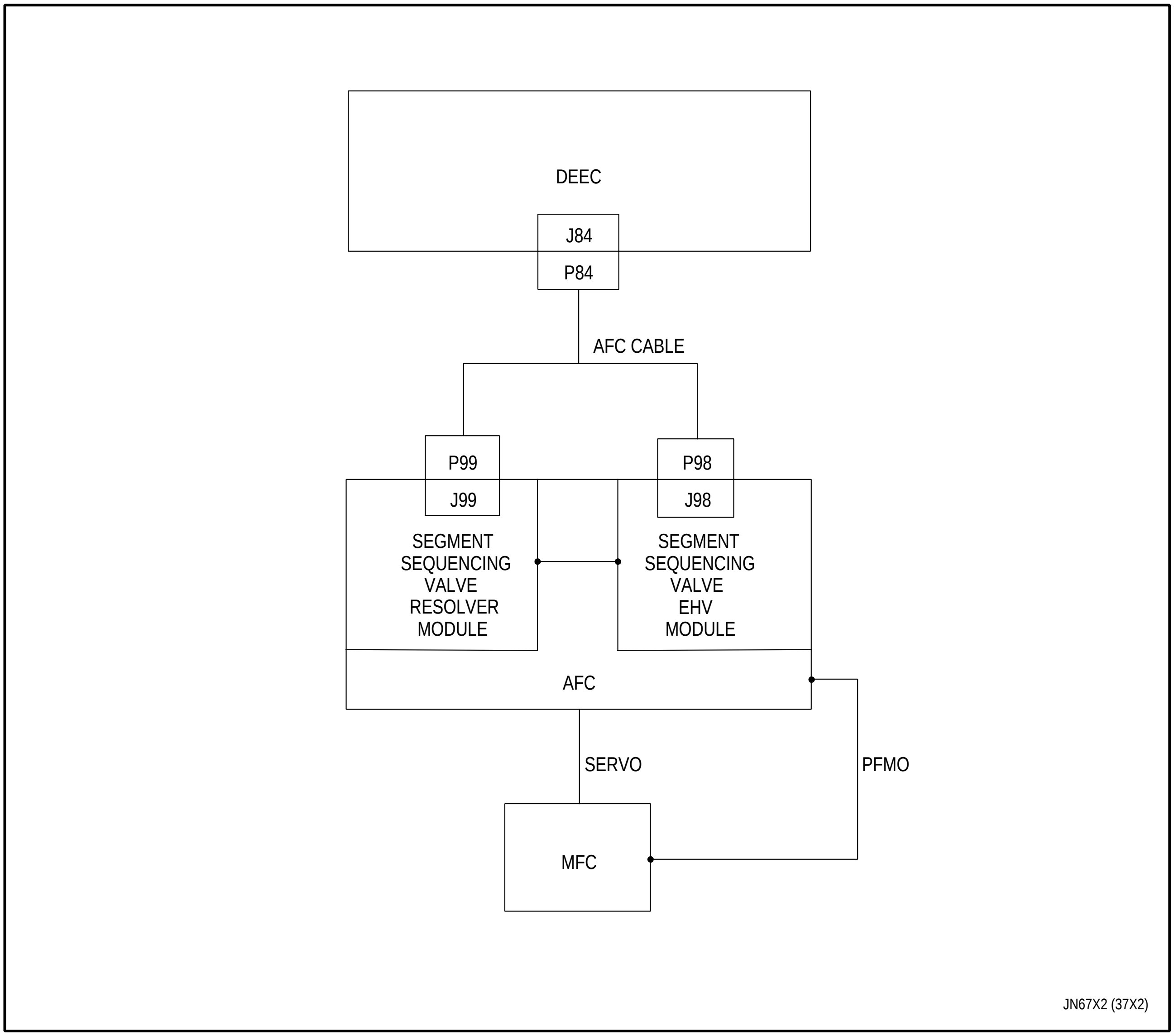


Figure 2. AFC Segment Sequencing Valve Open Loop

4. SYSTEM FAULT CODE 4022: AFC SEGMENT SEQUENCING VALVE EHV CIRCUIT. (See Figure 3, and Table 3.)

a. Cause of Fault:

(1) AFC segment sequencing valve open loop failure accompanied by current driver summation check failure.

b. Engine Symptoms:

(1) Augmentation inhibited

c. Test Cell Observations:

(1) Augmentation inhibited

(2) AUGMENTATION MN FAULT light on

(3) ENGINE CAUTION light on

(4) SYSTEM FAULT light on

(5) EDU Event Code 1220: Augmentation inhibited

Table 3. System Fault Code 4022: AFC SVP EHV Circuit

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks (See figure 3):		
	a. CONN P84 PINS 1. g to AA 2. h to AA	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace AFC cable.
	b. CONN P84 PINS 1. g to G 2. h to H 3. g to h 4. g to GND 5. h to GND	b.1. Resistance checks within limits: 1. 113 to 227 OHMS 2. 113 to 227 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Remove P98 from AFC segment sequencing valve EHV module. Go to c.
	c. CONN J98 PINS 1. A to B 2. C to D 3. A to C 4. A to GND 5. C to GND	c.1. Resistance checks within limits: 1. 113 to 227 OHMS 2. 113 to 227 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	c.1 Replace AFC cable.
		c.2. Resistance checks out of limits.	c.2. Replace AFC segment sequencing valve EHV module.

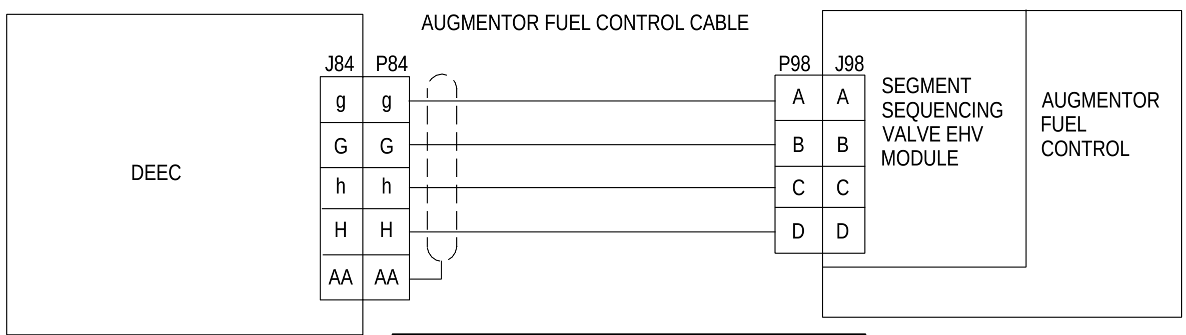
NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		

Table 3. System Fault Code 4022: AFC SVP EHV Circuit (continued)

Step	Procedure	Result	Corrective Action
3.	Perform IDLE functional check. Check for System Fault Code 4022. Replace components in following order until engine operates properly: • AFC segment • sequencing valve EHV • module DEEC AFC cable	a. System Fault 4022 does not repeat. b. System Fault Code 4022 repeats.	a. Return engine to service. b. Replace next component. Repeat steps 2 and 3.



SVP EHV RESISTANCE LIMITS		
PINS (P84)	PINS (J98)	OHMS
g–G	A–B	113–227
h–H	C–D	113–227
g–h	A–C	GT 100,000
g–GND	A–GND	GT 100,000
h–GND	C–GND	GT 100,000
g–AA		GT 100,000
h–AA		GT 100,000

JN51 (24X2)

Figure 3. AFC SVP EHV Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4030 - 4032: WFAC SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 11	0				
12 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Test Requirements	WP 206 00
Acceleration/Deceleration Checks	WP 213 00
Idle Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4030: AFC Core Metering Valve Resolver Position Out of Range	
	Ohmmeter	PSM-6 or equivalent
4	System Fault Code 4032: AFC Core Metering Valve EHV Circuit	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for WFAC system.

2. SYSTEM FAULT CODE 4030: AFC CORE METERING VALVE RESOLVER POSITION OUT OF RANGE.

(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) WFAC resolver out of 94-to-176 resolver-equivalent-degree (RED) range.

b. Engine Symptoms:

(1) Augmentation inhibited

c. Test Cell Observations:

(1) Augmentation inhibited

(2) AUGMENTOR MN FAULT light on

(3) ENGINE CAUTION light on

(4) SYSTEM FAULT light on

(5) EDU Event Code 1220: Augmentation inhibited

**Table 1. System Fault Code 4030:
AFC Core Metering Valve Resolver Position Out Of Range**

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks (See figure 1):		
	a. CONN P84 — PINS 1. X to AA 2. Z to AA	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace AFC cable.
	b. CONN P84 — PINS 1. X to Y 2. Z to u 3. Z to a 4. X to Z 5. X to GND 6. Z to GND	b.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Disconnect P101 from AFC core metering valve resolver module. Go to c.
	c. CONN J101 — PINS 1. A to B 2. C to D 3. C to E 4. A to C 5. A to GND 6. C to GND	c.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	c.1. Replace AFC cable.
		c.2. Resistance checks out of limits.	c.2. Replace AFC core metering valve resolver module.

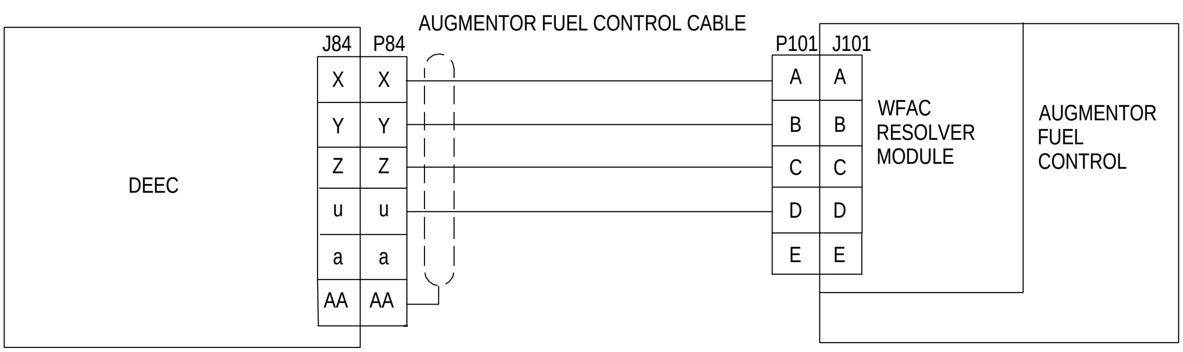
NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		

**Table 1. System Fault Code 4030:
AFC Core Metering Valve Resolver Position Out Of Range (continued)**

Step	Procedure	Result	Corrective Action
3.	Perform IDLE functional check. Check for System Fault Code 4030. Replace components in following order until engine operates properly: • AFC core metering valve assembly resolver module • DEEC • AFC • AFC cable	a. System Fault Code 4030 does not repeat. b. System Fault Code 4030 repeats.	a. Return engine to service. b. Replace next component and repeat steps 2 and 3.



WFAC RESOLVER RESISTANCE LIMITS		
PINS (P84)	PINS (J101)	OHMS
X-Y	A-B	43-117
Z-u	C-D	53-131
Z-a	C-E	53-131
X-Z	A-C	GT 100,000
X-GND	A-GND	GT 100,000
Z-GND	C-GND	GT 100,000
X-AA		GT 100,000
Z-AA		GT 100,000

JN52 (24X2)

Figure 1. AFC WFAC Resolver Circuit

3. SYSTEM FAULT CODE 4031: AFC CORE METERING VALVE POSITION OUT OF LIMITS.
(See Figure 2 and Table 2.)

NOTE

If this fault occurs after first start following engine fuel system maintenance, preservation, or initial assembly, no maintenance is required.

a. Cause of Fault:

(1) Difference between actual feedback error and calculated feedback error exceeds five resolver-equivalent degrees (RED):

Actual Error = WFAC Request - WFAC Resolver Feedback.

Calculated Error = WFAC Request - DEEC-Expected WFAC Feedback.

No other WFAC flags set.

b. Engine Symptoms:

(1) Augmentation inhibited

c. Test Cell Observations:

(1) Augmentation inhibited

(2) AUGMENTOR MN FAULT light on

(3) ENGINE CAUTION light on

(4) SYSTEM FAULT light on

(5) EDU Event Code 1220: Augmentation inhibited

Table 2. System Fault Code 4031:
AFC Core Metering Valve Position Out Of Limits

Step	Procedure	Result	Corrective Action
	NOTE • If this System Fault Code occurs simultaneously with System Fault Code 4190, troubleshooting of this fault code is unnecessary. (DEEC ID numbers 1-020400, 1-020401, and 1-020402 only). • Data not cleared from EDU may be misinterpreted as repeating fault or event.		
1.	Check that EDU data has been reviewed and stored; then clear EDU data.		
2.	Perform acceleration/ deceleration functional check with EAU in auto search mode. Check for System Fault Code 4031. Replace components in the following order until engine operates properly: • AFC core metering valve EHV module • DEEC • AFC • AFC cable	a. System Fault Code 4031 does not repeat. b. System Fault Code 4031 repeats.	a. Return engine to service. b. Replace next component. Repeat steps 1 and 2.

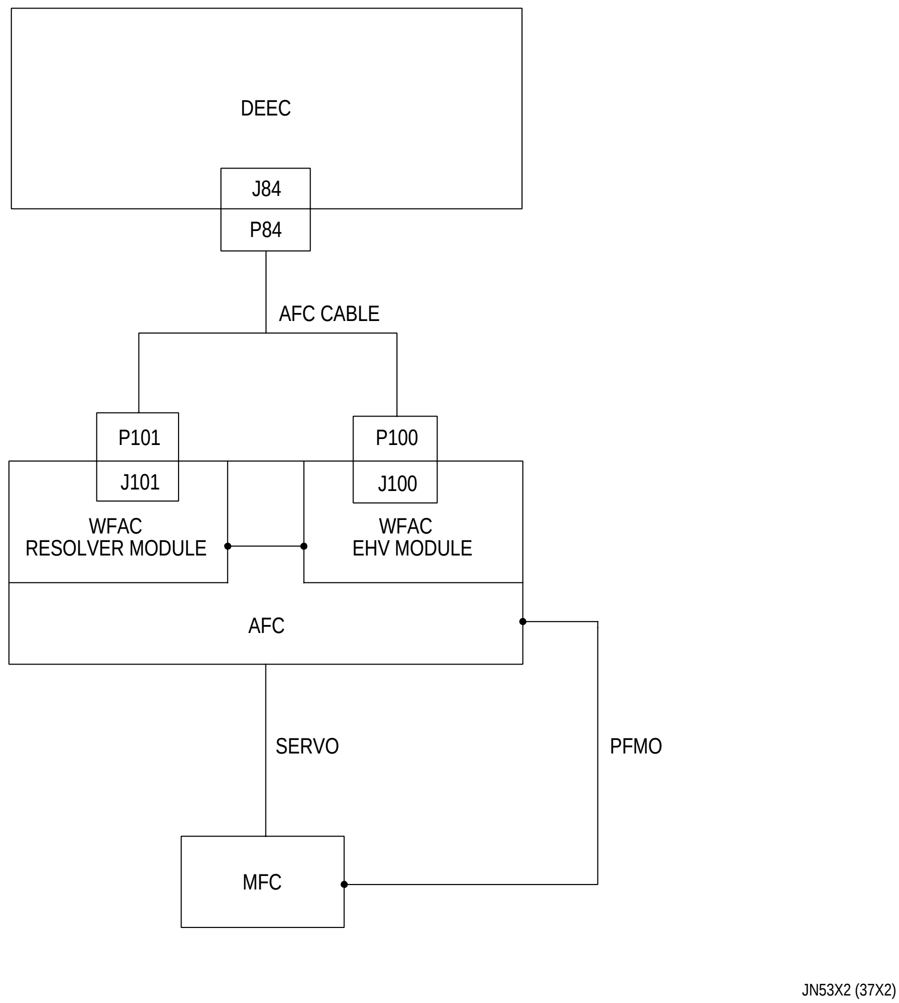


Figure 2. WFAC Circuit

4. SYSTEM FAULT CODE 4032: AFC CORE METERING VALVE EHV CIRCUIT.
(See Figure 3 and Table 3.)

a. Cause of Fault:

(1) WFAC open-loop failure accompanied by current driver summation check failure.

b. Engine Symptoms:

(1) Augmentation inhibited or cancelled

c. Test Cell Observations:

(1) Augmentation inhibited or cancelled

(2) AUGMENTOR/MN FAULT light on

(3) ENGINE CAUTION light on

(4) SYSTEM FAULT light on

(5) EDU Event Code 1220: Augmentation inhibited

Table 3. System Fault Code 4032:
AFC Core Metering Valve EHV Circuit

Step	Procedure	Result	Corrective Action
1.	Disconnect P84 from DEEC and perform following resistance checks (See figure 3):		
	a. CONN P84 — PINS 1. b to AA 2. c to AA	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace AFC cable.
	b. CONN P84 — PINS 1. b to A 2. c to B 3. b to c 4. b to GND 5. c to GND	b.1. Resistance checks within limits: 1. 113 to 227 OHMS 2. 113 to 227 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Disconnect P100 from AFC core metering valve EHV module. Go to c.
	c. CONN J100 — PINS 1. A to B 2. C to D 3. A to C 4. A to GND 5. C to GND	c.1. Resistance checks within limits: 1. 113 to 227 OHMS 2. 113 to 227 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	c.1 Replace AFC cable.
		c.2. Resistance checks out of limits.	c.2. Replace AFC core metering valve EHV module.

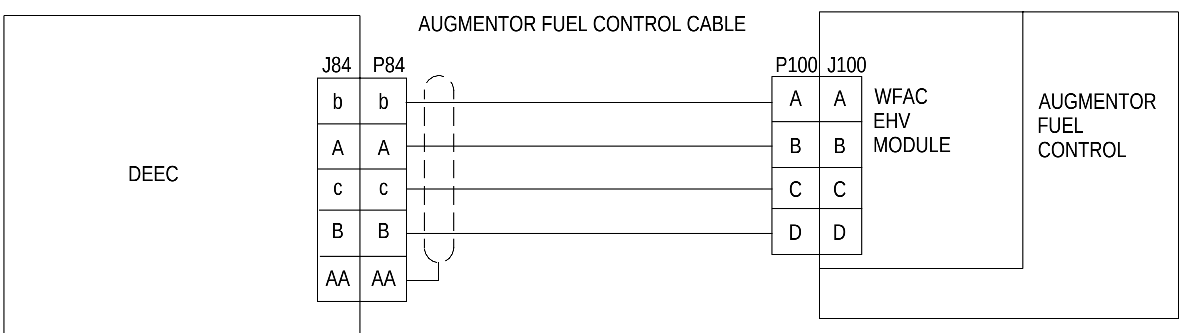
NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		

Table 3. System Fault Code 4032: AFC Core Metering Valve EHV Circuit (continued)

Step	Procedure	Result	Corrective Action
3.	Perform acceleration/ deceleration functional check. Check for System Fault Code 4032.	a. System Fault Code 4032 does not repeat.	a. Return engine to service.
	Replace component in the following order, if component has not been previously changed, until engine operates properly: • AFC core metering valve EHV module • DEEC • AFC cable	b. System Fault Code 4032 repeats.	b. Replace next component. Repeat steps 2 and 3.



WFAC EHV RESISTANCE LIMITS		
PINS (P84)	PINS (J100)	OHMS
b-A	A-B	113-227
c-B	C-D	113-227
b-c	A-C	GT 100,000
b-GND	A-GND	GT 100,000
c-GND	C-GND	GT 100,000
b-AA		GT 100,000
c-AA		GT 100,000

JN54 (24X2)

Figure 3. AFC WFAC EHV Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4040 - 4042: WFAD SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 11	0				
12 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Test Requirements	WP 206 00
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Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4040: AFC Duct Metering Valve Resolver Position Out of Range	
	Ohmmeter	PSM-6 or equivalent
4	System Fault Code 4042: AFC Duct Metering Valve EHV Circuit	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for WFAD system.

2. SYSTEM FAULT CODE 4040: AFC DUCT METERING VALVE RESOLVER POSITION OUT OF RANGE.

(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) WFAD valve resolver out of 94 to 176 resolver-equivalent-degree (RED) range.

b. Engine Symptoms:

(1) Augmentation limited to SEG 8 or may recycle from SEG 8. (PLA less than 107 degrees).

c. Test Cell Observations:

(1) Augmentation limited to SEG 8.

(2) AUGMENTOR/MN FAULT light on

(3) ENGINE CAUTION light on

(4) SYSTEM FAULT light on

(5) EDU Event Code 1220: Augmentation inhibited

Table 1. System Fault Code 4040:
AFC Duct Metering Valve Resolver Position Out Of Range

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks (See figure 1):		
	a. CONN P84 PINS 1. q to AA 2. s to AA	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace AFC cable.
	b. CONN P84 PINS 1. q to r 2. s to U 3. s to V 4. q to s 5. q to GND 6. s to GND	b.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Disconnect P103 from AFC duct metering valve resolver module. Go to c.
	c. CONN J103 PINS 1. A to B 2. C to D 3. C to E 4. A to C 5. A to GND 6. C to GND	c.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	c.1 Replace AFC cable.
		c.2. Resistance checks out of limits.	c.2. Replace AFC duct metering valve resolver module.

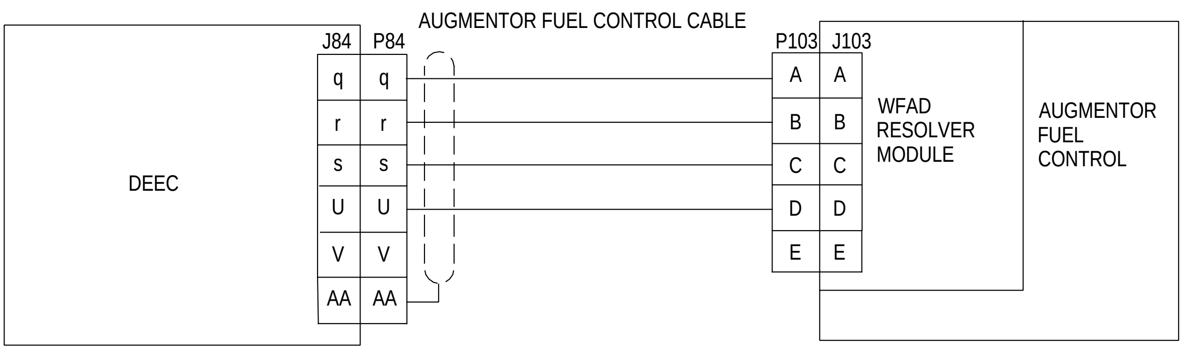
NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		

Table 1. System Fault Code 4040:
AFC Duct Metering Valve Resolver Position Out Of Range (continued)

Step	Procedure	Result	Corrective Action
3.	Perform IDLE functional check. Check for System Fault Code 4040. Replace components in following order, if component has not been previously changed, until engine operates properly: • AFC duct metering valve resolver module • DEEC • AFC • AFC cable	a. System Fault Code 4040 does not repeat. b. System Fault Code 4040 repeats.	a. Return engine to service. b. Replace next component and repeat steps 2 and 3.



WFAD RESOLVER RESISTANCE LIMITS		
PINS (P84)	PINS (J101)	OHMS
q-r	A-B	43-117
s-U	C-D	53-131
s-V	C-E	53-131
q-s	A-C	GT 100,000
q-GND	A-GND	GT 100,000
s-GND	C-GND	GT 100,000
q-AA		GT 100,000
s-AA		GT 100,000

JN55 (24X2)

Figure 1. AFC WFAD Resolver Circuit

3. SYSTEM FAULT CODE 4041: AFC DUCT METERING VALVE POSITION OUT OF LIMITS. (See Figure 2 and Table 2.)

NOTE

If this fault occurs after first start following engine fuel system maintenance, preservation, or initial assembly, no maintenance is required.

a. Cause of Fault:

(1) The DEEC expects a certain amount of error between its requested duct metering valve (DMV) position and the actual feedback position. When the actual error (DMV request from DEEC - actual DMV feedback) exceeds five resolver-equivalent degrees (RED), the DEEC then begins checking the calculated error (DEEC simulates the effector and calculates what the feedback should be). If the calculated error also exceeds five RED, then a timer is integrated. If the integrated timer exceeds 17 RED-seconds, the DMV open loop failure fault is declared. This fault normally indicates a binding problem within the DMV or DMV EHV.

b. Engine Symptoms:

(1) Augmentation limited to SEG 8 or may recycle from SEG 8.

c. Test Cell Observations:

(1) Augmentation limited to SEG 8 or may recycle from SEG 8.

(2) AUGMENTOR MN FAULT light on

(3) ENGINE CAUTION light on

(4) SYSTEM FAULT light on

(5) EDU Event Code 1220: Augmentation inhibited

Table 2. System Fault Code 4041:
AFC Duct Metering Valve Position Out Of Limits

Step	Procedure	Result	Corrective Action
	NOTE • If this System Fault Code occurs simultaneous with System Fault Code 4190, troubleshooting of this fault code is unnecessary. (DEEC ID numbers 1-020400, 1-020401 and 1-020402 only) • Data not cleared from EDU may be misinterpreted as repeating fault or event.		
1.	Check that EDU data has been reviewed and stored; then clear EDU data.		
2.	Perform acceleration/ deceleration functional check. Check for System Fault Code 4041. Replace components in following order, if component has not been previously changed, until engine operates properly: • AFC duct metering valve EHV module • DEEC • AFC	a. System Fault Code 4041 does not repeat. b. System Fault Code 4041 repeats	a. Return engine to service. b. Replace next component. Repeat steps 1 and 2.

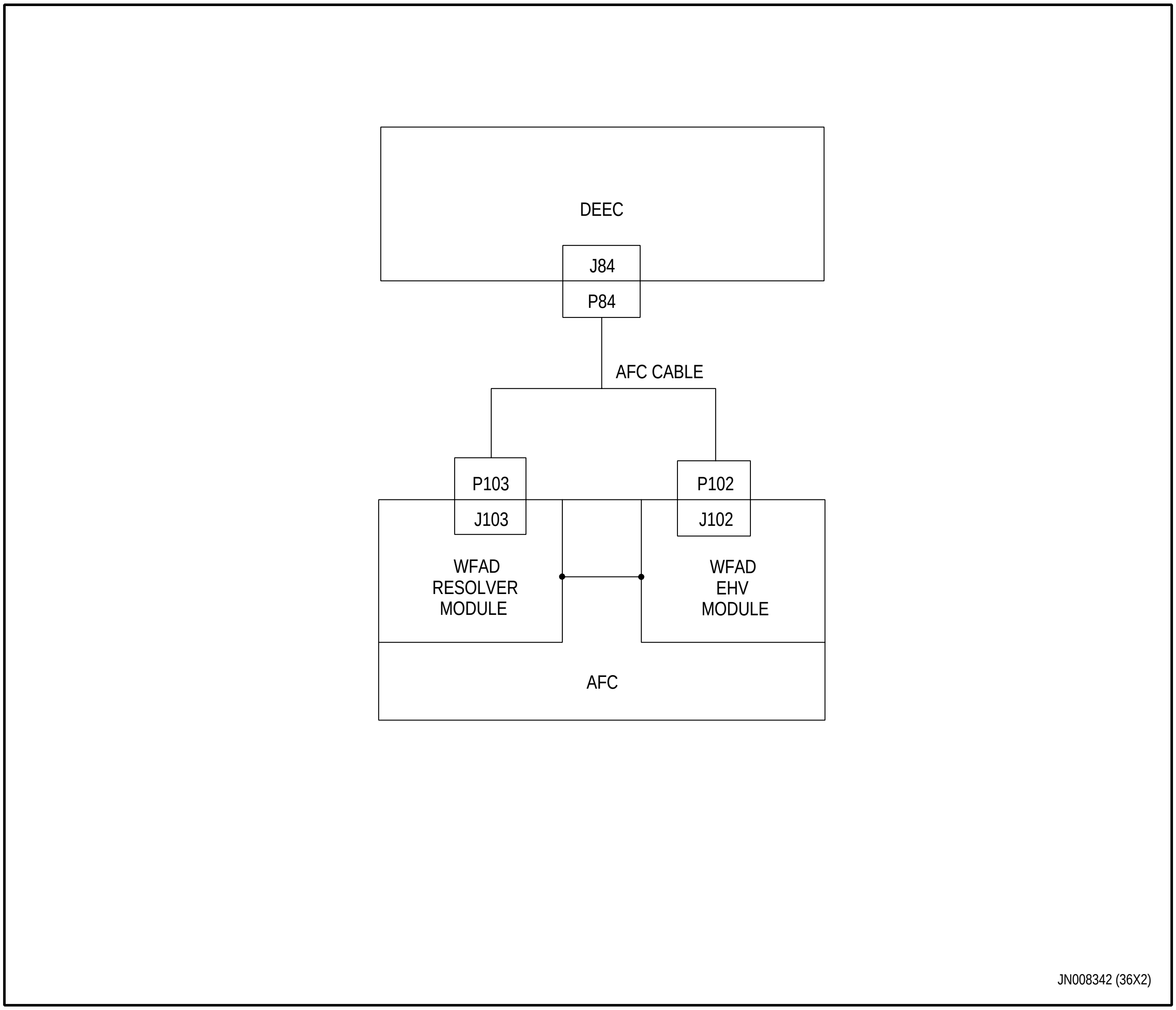


Figure 2. AFC WFAD Electrical Circuit

4. SYSTEM FAULT CODE 4042: AFC DUCT METERING VALVE EHV CIRCUIT.
(See Figure 3 and Table 3.)

a. Cause of Fault:

(1) WFAD open-loop failure accompanied by current driver summation check failure.

b. Engine Symptoms:

(1) Augmentation limited to SEG 8

c. Test Cell Observations:

(1) Augmentation limited to SEG 8

(2) AUGMENTOR/MN FAULT light on

(3) ENGINE CAUTION light on

(4) SYSTEM FAULT light on

(5) EDU Event Code 1220: Augmentation inhibited

Table 3. System Fault Code 4042: AFC Duct Metering Valve EHV Circuit

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks (See figure 3):		
	a. CONN P84 PINS 1. e to AA 2. f to AA	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace AFC cable.
	b. CONN P84 PINS 1. e to D 2. f to E 3. e to f 4. e to GND 5. f to GND	b.1. Resistance checks within limits: 1. 113 to 227 OHMS 2. 113 to 227 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Disconnect P102 from AFC duct metering valve EHV module. Go to c.
	c. CONN J102 PINS 1. A to B 2. C to D 3. A to C 4. A to GND 5. C to GND	c.1. Resistance checks within limits: 1. 113 to 227 OHMS 2. 113 to 227 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	c.1 Replace AFC cable.
		c.2. Resistance checks out of limits.	c.2. Replace AFC duct metering valve EHV module.

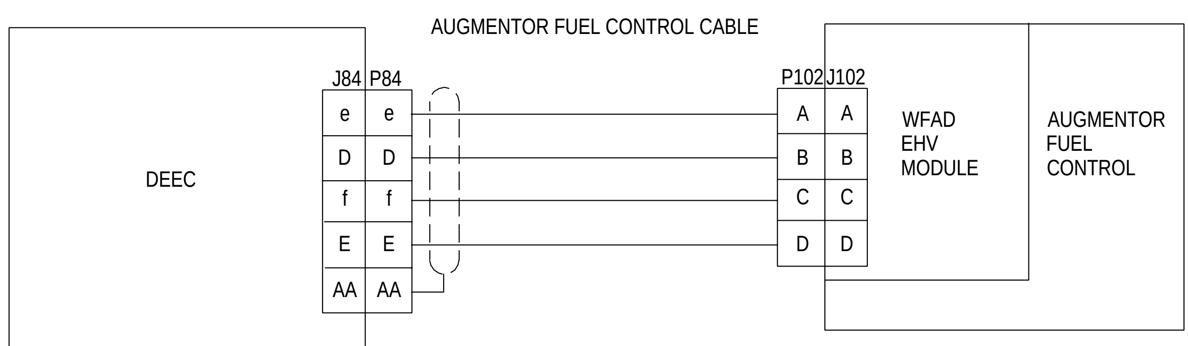
NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		

Table 3. System Fault Code 4042: AFC Duct Metering Valve EHV Circuit (continued)

Step	Procedure	Result	Corrective Action
3.	Perform acceleration/ deceleration functional check. Check for System Fault Code 4042. Replace components in following order, if component has not been previously changed, until engine operates properly: • AFC duct metering valve EHV module • DEEC • AFC cable	a. System Fault Code 4042 does not repeat. b. System Fault Code 4042 repeats.	a. Return engine to service. b. Replace next component. Repeat steps 2 and 3.



WFAD EHV RESISTANCE LIMITS		
PINS (J84)	PINS (J102)	OHMS
e-D	A-B	113-227
f-E	C-D	113-227
e-f	A-C	GT 100,000
e-GND	A-GND	GT 100,000
f-GND	C-GND	GT 100,000
e-AA		GT 100,000
f-AA		GT 100,000

JN69 (24X2)

Figure 3. AFC WFAD EHV Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4050 - 4054: RCVV SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 14

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Test Requirements	WP 206 00
Primary Mode Functional Check	WP 214 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Cylinders - Actuating, Linear, Variable Vane, Rear Compressor Rigging	WP 101 00
Control - Push-Pull, Rear Compressor Variable Vane Feedback - Rigging	WP 102 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
5	System Fault Code 4053: MFC RCVV EHV Circuit	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for the RCVV system.

2. SYSTEM FAULT CODE 4050: RCVV RESOLVER SIGNALS DIFFER.
(See Table 1.)

a. Cause of Fault:

(1) RCVV1 or RCVV2 resolver signal is 10 resolver equivalent degrees (RED) less than redundant signal, but still in range (94 to 176 RED).

b. Engine Symptoms:

(1) Engine uses redundant sensor.

c. Test Cell Observations (Either resolver malfunctions):

(1) SYSTEM FAULT light on.

Table 1. System Fault Code 4050: RCVV System Resolver Signals Differ

Step	Procedure	Result	Corrective Action
NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.			
1.	Check that EDU data has been reviewed and stored; then clear EDU data.		
2.	Perform IDLE functional check. Check for System Fault Code 4050. Replace components in following order until engine operates properly:	a. System Fault Code 4050 does not repeat.	a. Return engine to service.
	• LH RCVV actuatorRH • RCVV actuator • DEEC • Actuator cable.	b. System Fault Code 4050 repeats.	b. Replace next component and repeat steps 1 and 2.

3. SYSTEM FAULT CODE 4051: RCVV1 RESOLVER (LEFT) POSITION OUT OF RANGE. (See Figure 1 and Table 2.)

a. Cause of Fault:

(1) RCVV1 resolver signal out of 92 to 178 resolver equivalent degree (RED) range.

b. Engine Symptoms:

(1) Engine uses redundant sensor.

(2) Transfer to Secondary Mode if RCVV2 also malfunctions.

c. Test Cell Observations (System Fault Code 4051 only):

(1) SYSTEM FAULT light on.

d. Additional Test Cell Observations (System Fault Codes 4051 and 4054 present):

(1) SECONDARY CAUTION light on.

(2) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 2. System Fault Code 4051: RCVV1 Resolver (LEFT) Position Out Of Range

Step	Procedure	Result	Corrective Action
1.	Perform the following resistance checks. See figure 1.		
	a. CONN P85 PINS 1. P to BB 2. m to BB	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to step b.
		a.2. Resistance checks out of limits.	a.2. Replace actuator cable.
	b. CONN P85 PINS 1. P to R 2. m to n 3. m to AA 4. P to m 5. P to GND 6. m to GND	b.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Remove P89 connector from LH RCV actuator. Go to step c.
	c. CONN J89 PINS 1. A to B 2. C to D 3. C to E 4. A to C 5. A to GND 6. C to GND	c.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	c.1. Replace actuator cable.
		c.2. Resistance checks out of limits.	c.2. Replace LH RCVV actuator.
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform IDLE functional check. Check for System Fault Code 4051. Replace components in following order, if component has not been previously changed, until engine operates properly. • LH RCVV actuator • DEEC • Actuator cable	a. System Fault Code 4051 does not repeat.	a. Return engine to service.
		b. System Fault Code 4051 repeats.	b. Replace next component and repeat steps 2 and 3.

4. SYSTEM FAULT CODE 4052: RCVV POSITION OUT OF LIMITS.
(See Figure 1A and Table 3.)

NOTE

If this fault occurs after the first start following engine fuel system maintenance, preserving, or initial assembly, no maintenance is required.

a. Cause of Fault:

(1) Difference between actual feedback error and calculated feedback error exceeds five resolver-equivalent degrees (RED).

Actual Error = RCVV Request - RCVV Resolver Feedback.

Calculated Error = RCVV Request - DEEC-Expected RCVV Feedback.

No other RCVV flags set.

b. Engine Symptoms:

(1) Transfer to Secondary Mode

c. Test Cell Observations:

(1) SECONDARY CAUTION light on.

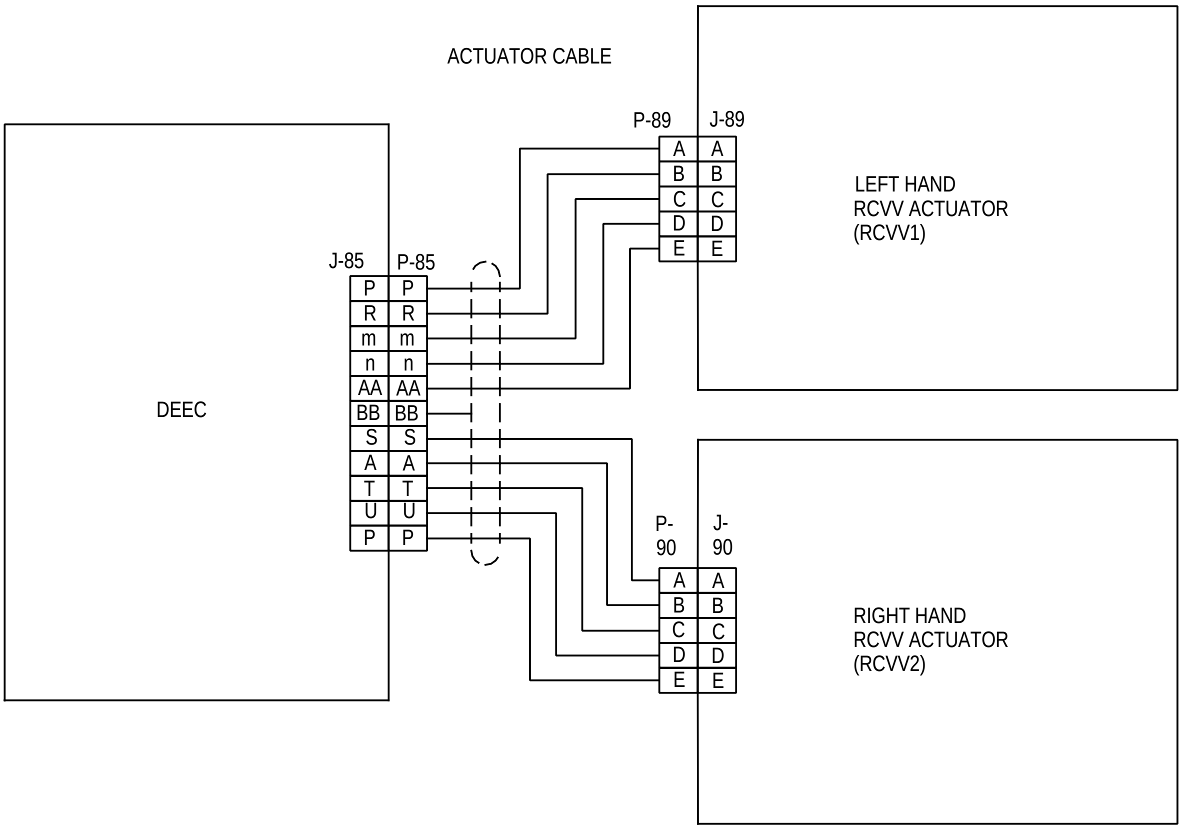
(2) SYSTEM FAULT light on.

(3) EDU Event Code 1200: Auto transfer to Secondary Mode.

d. Inspect RCVV system parts. (See figure 1A.)

Table 3. System Fault Code 4052: RCVV Position Out Of Limits

Step	Procedure	Result	Corrective Action
NOTE			
If this System Fault Code occurs simultaneously with Systems Fault Code 4190, troubleshooting of this fault code is unnecessary. (DEEC ID numbers 1-020400, 1-020401, and 1-020402 only).			
1.	Perform Secondary Mode fuel system analysis	a. System fails analysis.	a. Replace MFC
		b. System passes analysis.	b. Go to step 2.
NOTE			
Data not cleared from EDU may be misinterpreted as repeating fault or event.			
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform primary mode functional check. Check for System Fault Code 4052. Replace components in following order until engine operates properly:	a. System Fault Code 4052 does not repeat.	a. Return engine to service.
	• MFC • DEEC • RCVV cylinders • Actuator cables • MFC cable	b. System Fault Code 4052 repeats.	b. Replace next component and repeat steps 2 and 3.



RCVV1 RESOLVER RESISTANCE LIMITS		
PINS (P-85)	PINS (J-89)	OHMS
P-R	A-B	43-117
m-n	C-D	53-131
m-AA	C-E	53-131
P-m	A-C	GT 100,000
P-GND	A-GND	GT 100,000
m-GND	C-GND	GT 100,000
P-BB		GT 100,000
m-BB		GT 100,000

RCVV2 RESOLVER RESISTANCE LIMITS		
PINS (P-85)	PINS (J-90)	OHMS
S-A	A-B	43-117
T-U	C-D	53-131
T-p	C-E	53-131
S-T	A-C	GT 100,000
S-GND	A-GND	GT 100,000
T-GND	C-GND	GT 100,000
S-BB		GT 100,000
T-BB		GT 100,000

JN008338 (48X2)

Figure 1. RCVV Resolver Circuit

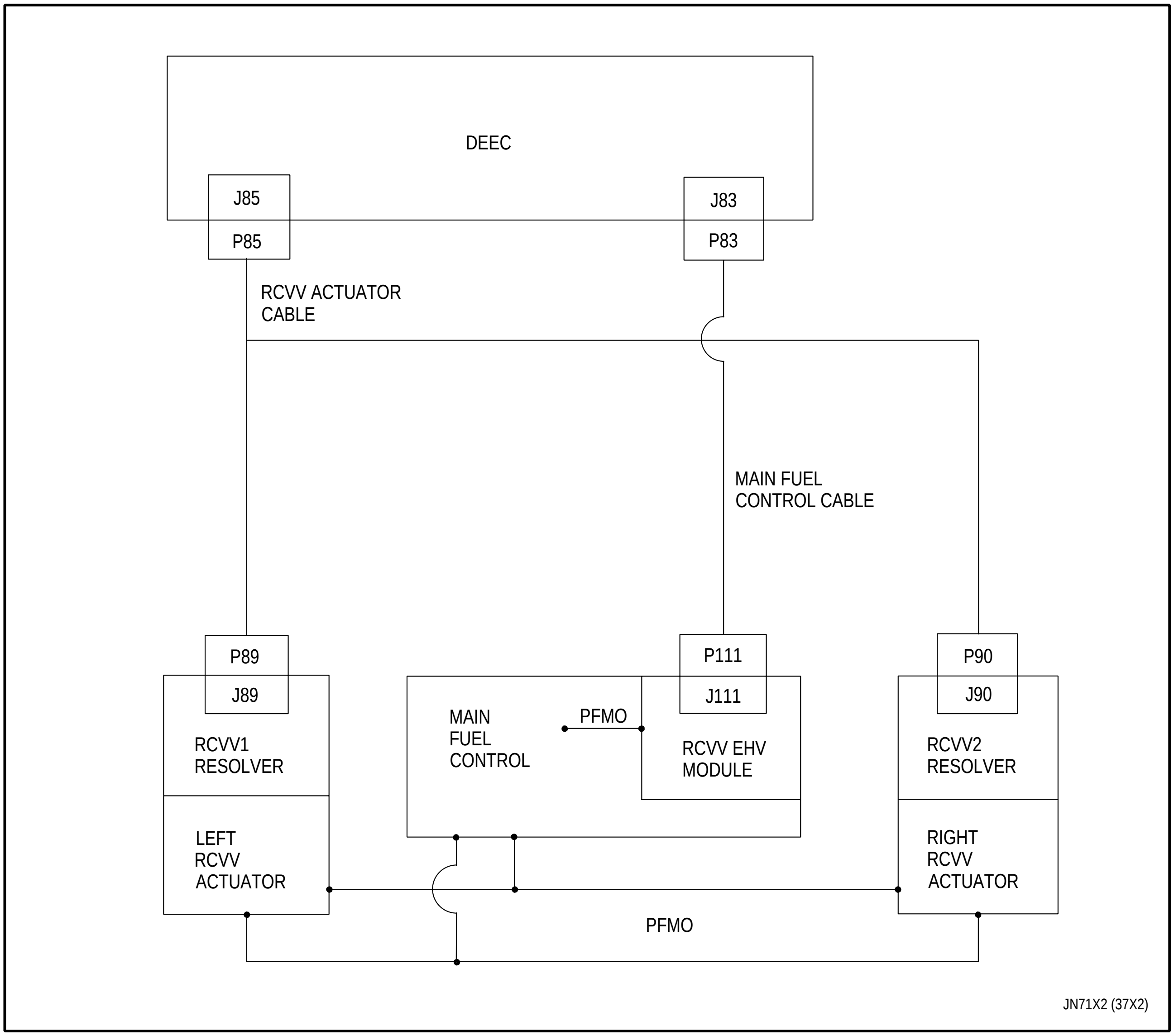


Figure 1A. RCVV Circuit

5. SYSTEM FAULT CODE 4053: MFC RCVV EHV CIRCUIT.
(See Figure 2 and Table 4.)

a. Cause of Fault:

(1) RCVV open loop failure accompanied by current driver summation check failure

b. Engine Symptoms:

(1) Transfer to Secondary Mode

c. Test Cell Observations:

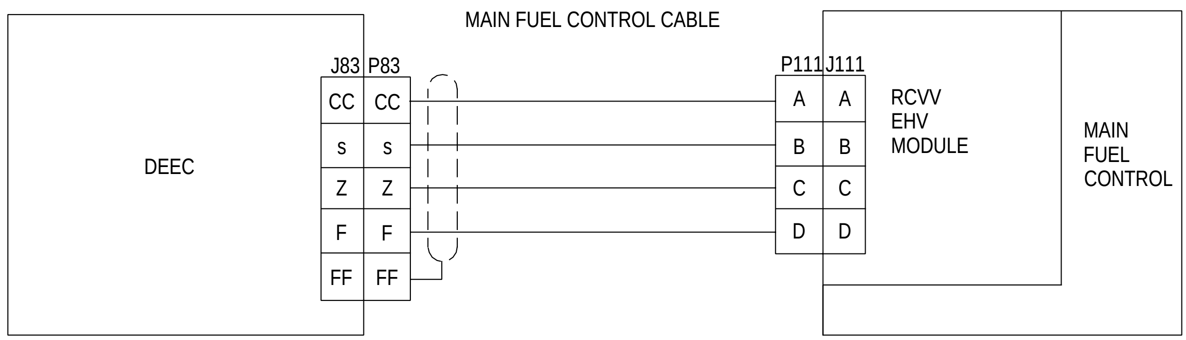
(1) SECONDARY CAUTION light on

(2) SYSTEM FAULT light on

(3) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 4. System Fault Code 4053: MFC RCVV EHV Circuit

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks. See figure 2.		
	a. CONN P83 PINS 1. CC to FF 2. Z to FF	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace MFC cable.
	b. CONN P83 PINS 1. CC to s 2. Z to F 3. CC to Z 4. CC to GND 5. Z to GND	b.1. Resistance checks within limits: 1. 113 to 227 OHMS 2. 113 to 227 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Disconnect P111 from MFC RCVV EHV module. Go to c.
	c. CONN J111 PINS 1. A to B 2. C to D 3. A to C 4. A to GND 5. C to GND	c.1. Resistance checks within limits: 1. 113 to 227 OHMS 2. 113 to 227 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	c.1 Replace MFC cable.
		c.2. Resistance checks out of limits.	c.2. Replace MFC RCVV EHV module.
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform Primary Mode functional check. Check for System Fault Code 4053. Replace components in following order until engine operates properly: • MFC RCVV EHV Module • DEEC • MFC cable	a. System Fault Code 4053 does not repeat. b. System Fault Code 4053 repeats.	a. Return engine to service. b. Replace next component and repeat steps 2 and 3.



RCVV EHV RESISTANCE LIMITS		
PINS (P83)	PINS (J111)	OHMS
CC-s	A-B	113-227
Z-F	C-D	113-227
CC-Z	A-C	GT 100,000
CC-GND	A-GND	GT 100,000
Z-GND	C-GND	GT 100,000
CC-FF		GT 100,000
Z-FF		GT 100,000

JN72X1 (24X2)

Figure 2. RCVV EHV Circuit

6. SYSTEM FAULT CODE 4054: RCVV2 RESOLVER (RIGHT) POSITION OUT OF RANGE. (See figure 1 and Table 5.)

a. Cause of Fault:

(1) RCVV2 resolver signal out of 92 to 178 resolver equivalent degree (RED) range

b. Engine System:

(1) Engine uses redundant sensor

(2) Transfer to Secondary Mode if RCVV1 also malfunctions.

c. Test Cell Observations (System Fault Code 4054 only):

(1) SYSTEM FAULT light on

d. Additional Test Cell Observations (System Fault Codes 4054 and 4051 present):

(1) SECONDARY CAUTION light on

(2) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 5. System Fault Code 4054: RCVV2 Resolver (Right) Position Out Of Range

Step	Procedure	Result	Corrective Action
1.	Perform the following resistance checks. See figure 1.		
	a. CONN P85 PINS 1. S to BB 2. T to BB	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to step b.
		a.2. Resistance checks out of limits.	a.2. Replace actuator cable.
	b. CONN P85 PINS 1. S to A 2. T to U 3. T to p 4. S to T 5. S to GND 6. T to GND	b.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Remove P90 connector from RH RCVV actuator. Go to step c.
	c. CONN J90 PINS 1. A to B 2. C to D 3. C to E 4. A to C 5. A to GND 6. C to GND	c.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	c.1. Replace actuator cable.
		c.2. Resistance checks out of limits.	c.2. Replace RH RCVV actuator.
NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.			
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform IDLE functional check. Check for System Fault Code 4054. Replace components in following order, if component has not been previously changed, until engine operates properly: • RH RCVV actuator • DEEC • Actuator cable	a. System Fault Code 4054 does not repeat. b. System Fault Code 4054 repeats.	a. Return engine to service. b. Replace next component and repeat steps 2 and 3.

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4060 - 4064: WFGG SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 14

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Testing Requirements	WP 206 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
Secondary Mode Fuel System Analysis	WP 663 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
5	System Fault Code 4063: MFC Metering Valve EHV Circuit	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for WFGG system.

2. SYSTEM FAULT CODE 4060: MFC METERING VALVE RESOLVER OUT OF RANGE.

(See Table 1.)

a. Cause of Fault.

(1) WFGG1 or WFGG2 resolver more than two resolver-equivalent degrees (RED) higher than redundant sensor, but still in range (50 to 220 RED).

b. Engine Symptoms:

(1) Engine uses redundant sensor.

c. Test Cell Observation

(1) SYSTEM FAULT light on

Table 1. System Fault Code 4060: MFC Metering Valve Resolver System Out Of Range

Step	Procedure	Result	Corrective Action
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
1.	Check that EDU data has been reviewed and stored; then clear EDU data.		
2.	Replace MFC metering valve resolver module.		Go to step 3.
3.	Perform IDLE functional check. Check for System Fault Code 4060. Replace components in following order until engine operates properly: • MFC metering valve resolver module • MFC • DEEC • MFC cable	a. System Fault Code 4060 does not repeat. b. System Fault Code 4060 repeats.	a. Return engine to service. b. Replace next component and repeat steps 1 and 3.

3. SYSTEM FAULT CODE 4061: MFC WFGG1 RESOLVER OUT OF RANGE.
(See Table 2.)

a. Cause of Fault:

(1) WFGG1 resolver out of 50 to 220 resolver-equivalent degree (RED) range

b. Engine Symptoms:

(1) Engine uses redundant sensor

(2) Transfer to Secondary Mode if WFGG2 resolver also malfunctions

c. Test Cell Observations (System Fault Code 4061 only):

(1) SYSTEM FAULT light on

d. Additional Test Cell Observations (System Fault Codes 4061 and 4062 present):

(1) SECONDARY CAUTION light on

(2) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 2. System Fault Code 4061: MFC WFGG1 Resolver Out Of Range

Step	Procedure	Result	Corrective Action
1.	Perform the following resistance checks (See figure 1):		
	a. CONN P83 PINS 1. R to FF 2. p to FF	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace MFC cable and MFC metering valve resolver module.
	b. CONN P83 PINS 1. R to S 2. p to n 3. p to T 4. R to p 5. R to GND 6. p to GND	b.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Replace MFC metering valve resolver module.
		b.2. Resistance checks out of limits.	b.2. Remove P109 connector from MFC metering valve resolver module. Go to c.

**Table 2. System Fault Code 4061:
MFC WFGG1 Resolver Out Of Range (continued)**

Step	Procedure	Result	Corrective Action
	c. CONN J109 PINS	c.1. Resistance checks within limits:	c.1. Replace MFC cable and MFC metering valve resolver module.
	1. A to B	1. 43 to 117 OHMS	
	2. C to D	2. 53 to 131 OHMS	
	3. C to E	3. 53 to 131 OHMS	
	4. A to C	4. GT 100,000 OHMS	
	5. A to GND	5. GT 100,000 OHMS	
	6. C to GND	6. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Replace MFC metering valve resolver module.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform IDLE functional check with EAU in Auto-Search mode. Check for System Fault Code 4062. Replace components in following order until engine operates properly:	a. System Fault Code 4062 does not repeat.	a. Return engine to service.
	• MFC • DEEC • MFC cable	b. System Fault Code 4062 repeats.	b. Replace next component and repeat steps 2 and 3.

4. SYSTEM FAULT CODE 4062: MFC WFGG2 RESOLVER OUT OF RANGE.
(See Table 3.)

a. Cause of Fault:

(1) WFGG2 resolver out of 50 to 220 resolver-equivalent degree (RED) range.

b. Engine Symptoms:

(1) Engine uses redundant signal sensor

(2) Transfer to Secondary Mode if WFGG1 resolver also malfunctions

c. Test Cell Observations (System Fault Code 4062 only):

(1) SYSTEM FAULT light on

d. Additional Test Cell Observations (System Fault Codes 4062 and 4061 present):

(1) SECONDARY CAUTION light on

(2) EDU Event Code 1200: Auto transfer to Secondary Mode present

Table 3. System Fault Code 4062: MFC WFGG2 Resolver Out Of Range

Step	Procedure	Result	Corrective Action
1.	Perform the following resistance checks (See figure 1):		
	a. CONN P83 PINS 1. P to FF 2. AA to FF	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace MFC cable and MFC metering valve resolver module.
	b. CONN P83 PINS 1. P to k 2. AA to m 3. AA to z 4. P to AA 5. P to GND 6. AA to GND	b.1. Resistance checks within limits: 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Replace MFC metering valve resolver module.
		b.2. Resistance checks out of limits.	b.2. Remove P109 connector from MFC metering valve resolver module. Go to c.

**Table 3. System Fault Code 4062:
MFC WFGG2 Resolver Out Of Range (continued)**

Step	Procedure	Result	Corrective Action
	c. CONN J109 PINS	c.1. Resistance checks within limits:	c.1. Replace MFC cable and MFC metering valve resolver module.
	1. F to G 2. H to J 3. H to K 4. F to H 5. F to GND 6. H to GND	1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Replace MFC metering valve resolver module.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform IDLE functional check with EAU in Auto-Search mode. Check for System Fault Code 4062. Replace components in following order until engine operates properly:	a. System Fault Code 4062 does not repeat.	a. Return engine to service.
	• MFC • DEEC • MFC cable	b. System Fault Code 4062 repeats.	b. Replace next component and repeat steps 2 and 3.

5. SYSTEM FAULT CODE 4063: MFC WFGG EHV CIRCUIT.

(See Figure 1 and Table 4.)

a. Cause of Fault:

(1) WFGG open loop failure accompanied by current driver-summation check failure.

b. Engine Symptoms:

(1) Transfer to Secondary Mode

c. Test Cell Observations:

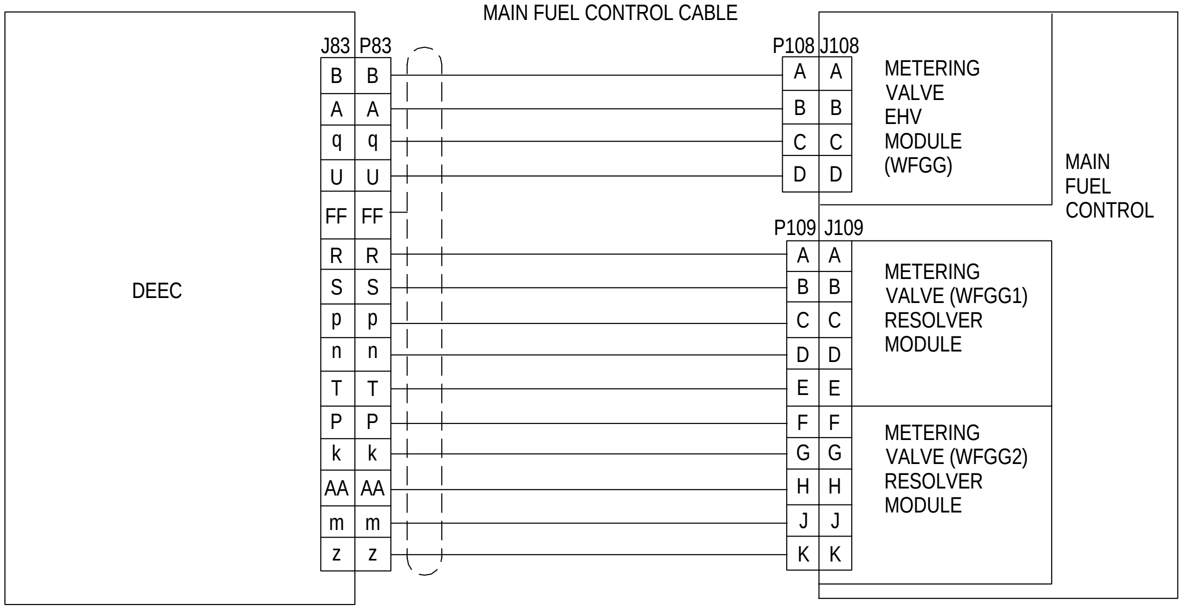
(1) SECONDARY CAUTION light on

(2) SYSTEM FAULT light on

(3) EDU Event Code 1200: Auto transfer to Secondary Mode.

Table 4. System Fault Code 4063: MFC WFGG EHV Circuit

Step	Procedure	Result	Corrective Action
	NOTE If this System Fault Code occurs simultaneous with System Fault Code 4190, troubleshooting of this fault code is unnecessary. (DEEC ID numbers 1-020400, 1-020401 and 1-020402 only).		
1.	Perform the following resistance checks (See figure 1):		
	a. CONN P83 PINS 1. B to FF 2. q to FF	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace MFC cable.
	b. CONN P83 PINS 1. B to A 2. q to U 3. B to q 4. B to GND 5. q to GND	b.1. Resistance checks within limits: 1. 113 to 227 OHMS 2. 113 to 227 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Disconnect P108 from MFC metering valve EHV module. Go to c.
	c. CONN J108 PINS 1. A to B 2. C to D 3. A to C 4. A to GND 5. C to GND	c.1. Resistance checks within limits: 1. 113 to 227 OHMS 2. 113 to 227 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	c.1. Replace MFC cable.
		c.2. Resistance checks out of limits.	c.2. Replace MFC metering valve EHV module.
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform Primary Mode functional check. Check for System Fault Code 4063. Replace components in following order until engine operates properly:	a. System Fault Code 4063 does not repeat.	a. Return engine to service.
	• MFC metering valve EHV module • DEEC • MFC cable	b. System Fault Code 4063 repeats.	b. Replace next component and repeat steps 2 and 3.



WFGG EHV RESISTANCE LIMITS		
PINS (P83)	PINS (J108)	OHMS
B-A	A-B	113-227
q-U	C-D	113-227
B-q	A-C	GT 100,000
B-GND	A-GND	GT 100,000
q-GND	C-GND	GT 100,000
B-FF		GT 100,000
q-FF		GT 100,000

WFGG1 RESOLVER RESISTANCE LIMITS		
PINS (P83)	PINS (J109)	OHMS
R-S	A-B	43-117
p-n	C-D	53-131
p-T	C-E	53-131
R-p	A-C	GT 100,000
R-GND	A-GND	GT 100,000
p-GND	C-GND	GT 100,000
R-FF		GT 100,000
p-FF		GT 100,000

WFGG2 RESOLVER RESISTANCE LIMITS		
PINS (P83)	PINS (J109)	OHMS
P-k	F-G	43-117
AA-m	H-J	53-131
AA-z	H-K	53-131
P-AA	F-H	GT 100,000
P-GND	F-GND	GT 100,000
AA-GND	H-GND	GT 100,000
P-FF		GT 100,000
AA-FF		GT 100,000

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Figure 1. WFGG Circuit

6. SYSTEM FAULT CODE 4064: MFC WFGG POSITION OUT OF LIMITS.
(See Table 5.)

NOTE

If this fault occurs after the first start following engine fuel system maintenance, preservation, or initial assembly, no maintenance is required.

a. Cause of Fault:

(1) Difference between actual feedback error and calculated feedback error exceeds seven resolver-equivalent degrees (RED).

Actual Error = WFGG Request - WFGG Resolver Feedback

Calculated Error = WFGG Request - DEEC Expected WFGG Feedback

b. Engine Symptoms:

(1) Transfer to Secondary Mode

c. Test Cell Observations:

(1) SECONDARY CAUTION light on

(2) SYSTEM FAULT light on

(3) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 5. System Fault Code 4064: MFC Metering Valve Position Out Of Limits

Step	Procedure	Result	Corrective Action
	NOTE If this System Fault Code occurs simultaneous with System Fault Code 4190, troubleshooting of this fault code is unnecessary. (DEEC ID numbers 1-020400, 1-020401 and 1-020402 only).		
1.	Perform Secondary Mode fuel system analysis.	a. System passes analysis.	a. Go to step 2.
		b. System fails analysis.	b. Replace MFC.
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform Primary Mode functional check. Check for System Fault Code 4064. Replace components in following order until engine operates properly:	a. System Fault Code 4064 does not repeat.	a. Return engine to service.
	• MFC metering valve • EHV • MFC • DEEC • MFC Cable	b. System Fault Code 4064 repeats.	b. Replace next component and repeat steps 2 and 3.

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4070 - 4075: FTIT SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 24

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	21	8 - 15	0	19	18
3 - 5	0	16 - 18	18	20	21
6	21	18A - 18B Added	18	21	0
7	18			22 Blank	0

REFERENCE MATERIAL REQUIRED

Title	Number
Depot Engine Test	T.O. 2J-F100-11-2
Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00
Engine Start Procedures	WP 210 00
Acceleration/Deceleration Checks	WP 213 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4070: FTITA and/or FTITB Temperature Signal Out of Range	
	Ohmmeter	PSM-6 or equivalent
3	System Fault Code 4071: Real or Predicted FTIT Overtemperature	
	Ohmmeter	PSM-6 or equivalent
4	System Fault Code 4072: DEEC FTITA Out of Range	
	Ohmmeter	PSM-6 or equivalent
5	System Fault Code 4073: DEEC FTITB Out of Range	
	Ohmmeter	PSM-6 or equivalent
6	System Fault Code 4074: EDU FTIT Exceeds Scheduled Limit	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for FTIT system.

2. SYSTEM FAULT CODE 4070: FTITA AND/OR FTITB SIGNAL OUT OF RANGE. (See Figure 1 and Table 1.)

a. Cause of Fault:

(1) FTITA and FTITB signals are more than 200°F (93°C) apart.

b. Engine Symptoms:

(1) If the two FTIT sensor values differ by more than 200°F (93°C), the higher value is used. Small thrust loss at Intermediate (MIL) may be noted if FTIT within range.

(2) If both sensor values exceed the range, FTIT is calculated using Pb/Pt2 and maximum scheduled N2 is reduced by 1000 rpm. Small scheduled thrust loss at Intermediate (MIL) may be noted.

c. Test Cell Observations (Either signal malfunctions):

(1) No engine effect

(2) SYSTEM FAULT light on

d. Additional Test Cell Observations (Both signals malfunction):

(1) Reduced Intermediate (MIL) thrust parameters

(2) ENGINE CAUTION light on

(3) EDU Event Code 1210: Low scheduled thrust

**Table 1. System Fault Code 4070:
FTITA and/or FTITB Temperature Signal Out Of Range**

Step	Procedure	Result	Corrective Action
1.	Review event and fault data for 5000-series FTIT faults.	a. 5000-series faults present.	a. Troubleshoot indicated probe, then go to step 2.
		b. No 5000-series faults present	b. Go to step 2.
2.	Perform the following resistance checks. See figure 1.		
	a. CONN P81 PINS 1. T to X 2. U to X 3. V to X 4. W to X	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace temperature cable.
	b. CONN P81 PINS 1. T to U 2. U to GND 3. T to GND 4. V to W 5. V to GND 6. W to GND	b.1. Resistance checks within limits: 1. LT 20 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 20 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHM	b.1. Go to step 4.
		b.2. Resistance checks out of limits.	b.2. If any of resistance checks b.1. (1 through 3) (FTITA) are out of limits, perform step c. on each probe below. FTIT Probe CONN 1 J38 3 J40 5 J42 7 J44 If any of resistance checks b.1. (4 through 6) (FTITB) are out of limits, perform step c. on each probe below. FTIT Probe CONN 2 J39 4 J41 6 J43

Table 1. System Fault Code 4070: FTITA and/or FTITB Temperature Signal Out Of Range (continued)

Step	Procedure	Result	Corrective Action
2.	(continued) c. CONN PINS J38 to J44 1. A to D 2. B to C 3. A to C 4. B to D 5. A to GND 6. B to GND 7. C to GND 8. D to GND	c.1. Resistance checks within limits: 1. LT 5 OHMS 2. LT 5 OHMS 3. GT 750,000 OHMS 4. GT 750,000 OHMS 5. GT 750,000 OHMS 6. GT 750,000 OHMS 7. GT 750,000 OHMS 8. GT 750,000 OHMS c.2. Resistance checks out of limits.	c.1. Replace temperature cable. c.2. Replace out of limit FTIT probes.

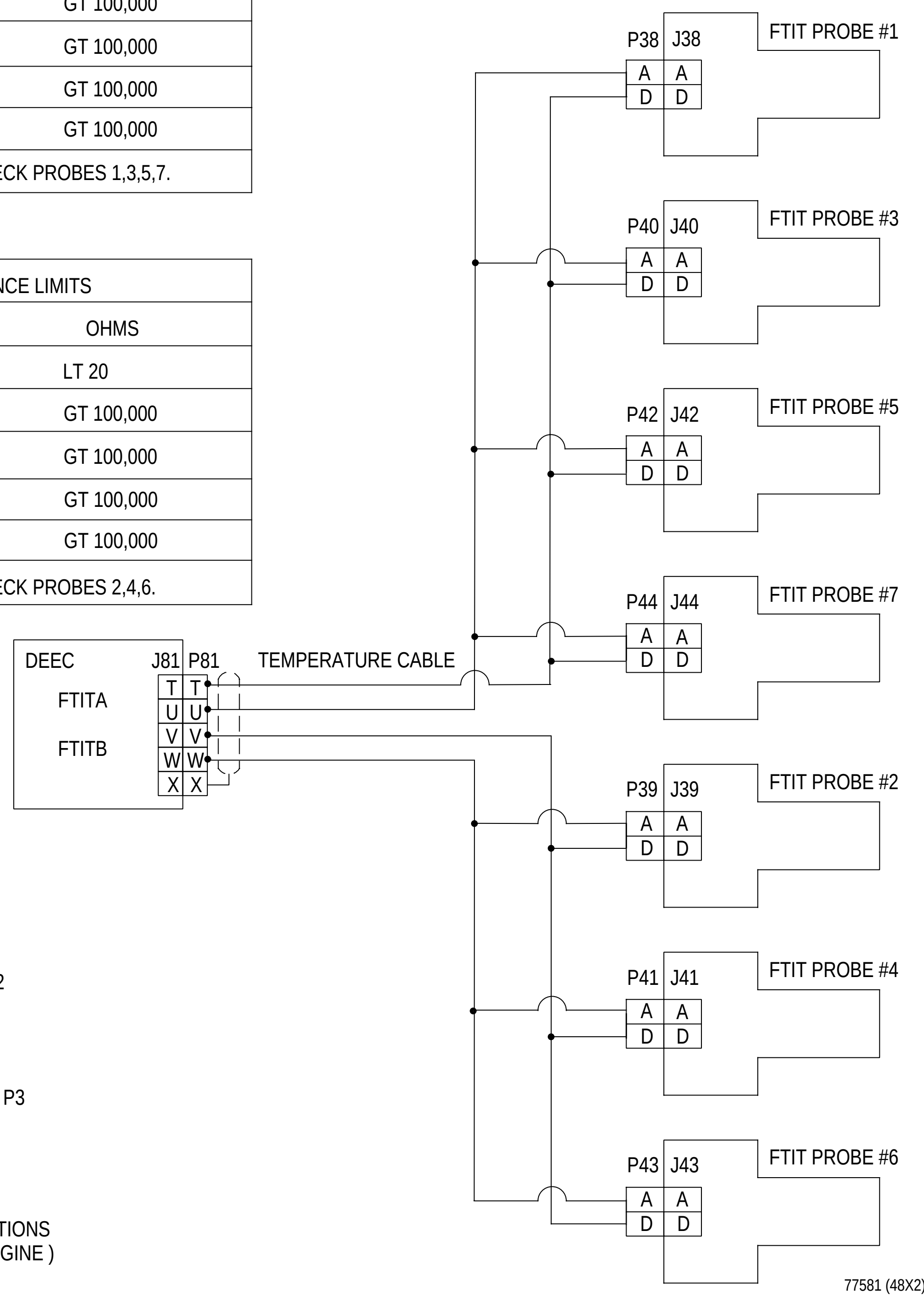
NOTE

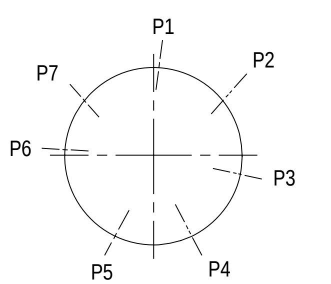
Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored; then clear EDU data.		
4.	Perform engine start per WP 210 00. Stabilize at IDLE for 9 minutes. Accel to Intermediate (MIL) and stabilize 3 minutes. Monitor FTIT parameters at stabilized MIL and compare to MIL FTIT spread and instability limits.	a. FTIT parameters out of limits: 1. Individual FTIT probes for stability. 2. FTIT spread. b. FTIT within limits per WP 205 00.	1. Replace probe. 2. Troubleshoot per WP 542 00. b. Go to step 5.
5.	Check for System Fault Code 4070.	a. System Fault Code 4070 repeats. b. System Fault Code 4070 does not repeat.	a. Replace components one at a time as follows: • FTIT Probes • DEEC • Temperature Cable Repeat steps 4 and 5 until engine operates normally. b. Return engine to service.

FTITA RESISTANCE LIMITS	
PINS (P81)	OHMS
T TO U	LT 20
U TO GND	GT 100,000
T TO GND	GT 100,000
T TO X	GT 100,000
U TO X	GT 100,000
IF P81 CHECKS OUT OF LIMITS, CHECK PROBES 1,3,5,7.	

FTITB RESISTANCE LIMITS	
PINS (P81)	OHMS
V TO W	LT 20
V TO GND	GT 100,000
W TO GND	GT 100,000
V TO X	GT 100,000
W TO X	GT 100,000
IF P81 CHECKS OUT OF LIMITS, CHECK PROBES 2,4,6.	



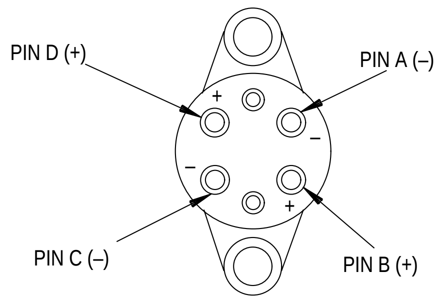


FTIT PROBE PHYSICAL LOCATIONS
(LOOKING FROM REAR OF ENGINE)

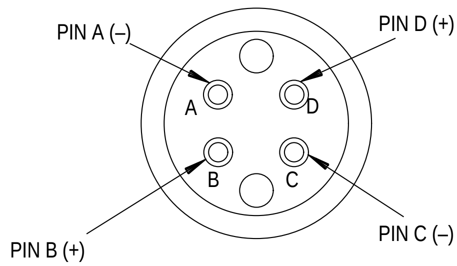
Figure 1. FTITA and FTITB Probe Circuits (Sheet 1 of 2)

NOTE

VERIFY FTIT PROBE PIN DESIGNATIONS BY COMPARING THEM TO LETTERED PINS IN HARNESS CAP



FTIT PROBE – TOP VIEW



FTIT HARNESS CAP – INSIDE VIEW

RESISTANCE LIMITS AT FTIT PROBE		
CONNECTORS	PINS	OHMS
J38 THRU J44	B TO C	LT 5
	B TO GND	GT 750,000
	C TO GND	GT 750,000
	A TO D	LT 5
	A TO GND	GT 750,000
	D TO GND	GT 750,000
	A TO C	GT 750,000
	B TO D	GT 750,000

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Figure 1. FTITA and FTITB Probe Circuits (Sheet 2 of 2)

3. SYSTEM FAULT CODE 4071: REAL OR PREDICTED FTIT OVERTEMPERATURE.
(See figure 1 and Table 2.)

a. Cause of Fault:

NOTE

This flag does not necessarily indicate that an overtemperature has occurred.

(1) FTIT exceeds, or is predicted to exceed DEEC overtemperature limits and the EDU did not detect a FTIT overtemperature.

(2) Excessive fuel flow and/or airflow scheduling resulting from control system malfunction.

b. Engine Symptoms:

(1) Transfer to Secondary Mode

c. Test Cell Observations:

(1) SYSTEM FAULT light on

(2) SECONDARY CAUTION light on

(3) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 2. System Fault Code 4071: Real or Predicted FTIT Overtemperature

Step	Procedure	Result	Corrective Action
1.	Review event data for Event Code 1070 - FTIT overtemperature. Compare data to engine operating limits.	a. Event Code 1070 not present.	a. Go to step 2.
		b. Event Code 1070 present.	b. Troubleshoot Event Code 1070.
2.	Review event and fault data for FTIT faults.	a. FTIT events or faults present.	a. Troubleshoot FTIT events or faults.
		b. No FTIT events or faults present.	b. Go to step 3.

**Table 2. System Fault Code 4071:
Real or Predicted FTIT Overtemperature (continued)**

Step	Procedure	Result	Corrective Action
3.	Perform the following resistance checks. See figure 1.		
	a. CONN P81 PINS 1. T to X 2. U to X 3. V to X 4. W to X	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace temperature cable.
	b. CONN P81 PINS 1. T to U 2. U to GND 3. T to GND 4. V to W 5. V to GND 6. W to GND	b.1. Resistance checks within limits: 1. LT 20 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 20 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Go to step 5.
		b.2. Resistance checks out of limits.	b.2. If any of resistance checks b.1. (1 through 3) (FTITA) are out of limits, perform c. on each probe below. FTIT Probe CONN 1 J38 3 J40 5 J42 7 J44 If any of resistance checks b.1.(4 through 6) (FTITB) are out of limits, perform c. on each probe below. FTIT Probe CONN 2 J39 4 J41 6 J43

**Table 2. System Fault Code 4071:
Real or Predicted FTIT Overtemperature (continued)**

Step	Procedure	Result	Corrective Action
3. (cont'd)	c. CONN J38 to J44 — PINS 1. A to D 2. B to C 3. A to C 4. B to D 5. A to GND 6. B to GND 7. C to GND 8. D to GND	c.1. Resistance checks within limits: 1. LT 5 OHMS 2. LT 5 OHMS 3. GT 750,000 OHMS 4. GT 750,000 OHMS 5. GT 750,000 OHMS 6. GT 750,000 OHMS 7. GT 750,000 OHMS 8. GT 750,000 OHMS	c.1. Replace temperature cable.
		c.2. Resistance checks out of limits.	c.2. Replace FTIT probes with out of limits resistance.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
4.	Check that EDU data has been reviewed and stored; then clear EDU data.		
5.	Operate engine at Intermediate (MIL). Check for System Fault Code 4071. Replace components in the following order until engine operates properly:	a. System Fault Code 4071 does not repeat.	a. Return engine to service.
	• FTIT Probes • DEEC • Temperature Cables • MFC	b. System Fault Code 4071 repeats.	b. Replace next component and repeat steps 4 and 5.

4. SYSTEM FAULT CODE 4072: DEEC FTITA SIGNAL OUT OF RANGE.
(See figure 1 and Table 3.)

a. Cause of Fault:

(1) DEEC FTITA signal out of –74° to 2499°F (–58° to 1371°C) range.

b. Engine Symptoms:

(1) No effect on engine operation. Other sensor signal used.

c. Test Cell Observations (System Fault Code 4073 only):

(1) No engine effect

(2) SYSTEM FAULT light on

d. Additional Test Cell Observations (System Fault Codes 4073 and 4072, and DEEC FTITA Out Of Range):

(1) Reduced Intermediate (MIL) thrust parameters

(2) ENGINE CAUTION light on

(3) EDU Event Code 1210: Low scheduled thrust

Table 3. System Fault Code 4072: DEEC FTITA Signal Out of Range

Step	Procedure	Result	Corrective Action
1.	Review event and fault data for System Fault Codes 5011, 5013, 5015 and 5017.	a. Fault codes present.	a. Troubleshoot fault codes, then go to step 4.
		b. No fault codes present.	b. Go to step 2.
2	Perform the following resistance checks. See figure 1.		
	a CONN P81 PINS 1. T to X 2. U to X 3. V to X 4. W to X	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	a.1. Go to b.
		a.2 Resistance checks out of limits.	a.2. Replace temperature cable.
	b. CONN P81 PINS 1. T to U 2. U to GND 3. T to GND	b.1. Resistance checks within limits 1. LT 20 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	b.1 Go to step 3.
		b.2. Resistance checks out of limits.	b.2. Go to c.

Table 3. System Fault Code 4072:
DEEC FTITA Signal Out of Range (continued)

Step	Procedure	Result	Corrective Action
2. (cont'd)	c. CONN J38, J40, J42, J44 — PINS		
		c.1. Resistance checks within limits:	c.1. Replace temperature cable.
	1. A to D	1. LT 5 OHMS	
	2. B to C	2. LT 5 OHMS	
	3. A to C	3. GT 750,000 OHMS	
	4. B to D	4. GT 750,000 OHMS	
	5. A to GND	5. GT 750,000 OHMS	
	6. B to GND	6. GT 750,000 OHMS	
	7. C to GND	7. GT 750,000 OHMS	
	8. D to GND	8. GT 750,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Replace out-of-limit FTIT probes.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored; then clear EDU data.		
4.	Perform IDLE functional check. Check for System Fault Code 4072. Replace components in the following order until engine operates properly:	a. System Fault Code 4072 does not repeat.	a. Return engine to service
	• FTIT Probes 1,3,5, and 7 • DEEC • Temperature Cables	b. System Fault Code 4072 repeats.	b. Replace next component and repeat steps 3 and 4.

5. SYSTEM FAULT CODE 4073: DEEC FTITB SIGNAL OUT OF RANGE.
(See figure 1 and Table 4.)

a. Cause of Fault:

(1) DEEC FTITB signal out of −74° to 2499°F (−58° to 1371°C) range

b. Engine Symptoms:

(1) No effect on engine operation. Other sensor signal used.

c. Test Cell Observations (System Fault Code 4073 only):

(1) No engine effect

(2) SYSTEM FAULT light on

d. Additional Test Cell Observations (System Fault Codes 4073 and 4072, and DEEC FTITA Out Of Range):

(1) Reduced Intermediate (MIL) thrust parameters

(2) ENGINE CAUTION light on

(3) EDU Event 1210: Low scheduled thrust

Table 4. System Fault Code 4073: DEEC FTITB Signal Out of Range

Step	Procedure	Result	Corrective Action
1.	Review event and fault data for System Fault Codes 5012, 5014, and 5016.	a. Fault codes present.	a. Troubleshoot fault codes, then go to step 4.
		b. No fault codes present.	b. Go to step 2.
2.	Perform the following resistance checks. See figure 1.		
	a. CONN P81 PINS 1. T to X 2. U to X 3. V to X 4. W to X	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	a.1. Go to b.
		a.2 Resistance checks out of limits.	a.2 Replace temperature cable.
	b. CONN P81 PINS 1. V to W 2. V to GND 3. W to GND	b.1. Resistance checks within limits: 1. LT 20 OHMS 2. GT 100,000 OHMS 3. FT 100,000 OHMS	b.1. Go to step 3.
		b.2. Resistance checks out of limits.	b.2. Go to c.

**Table 4. System Fault Code 4073:
DEEC FTITB Signal Out of Range (continued)**

Step	Procedure	Result	Corrective Action
2. (cont'd)	c. CONN J39, J41, J43 — PINS 1. A to D 2. B to C 3. A to C 4. B to D 5. A to GND 6. B to GND 7. C to GND 8. D to GND	c.1. Resistance checks within limits: 1. LT 5 OHMS 2. LT 5 OHMS 3. GT 750,000 OHMS 4. GT 750,000 OHMS 5. GT 750,000 OHMS 6. GT 750,000 OHMS 7. GT 750,000 OHMS 8. GT 750,000 OHMS	c.1. Replace temperature cable.
		c.2. Resistance checks out of limits.	c.2. Replace out-of-limits FTIT probes.
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
3.	Check that EDU data has been reviewed and stored; then clear EDU data.		
4.	Perform IDLE functional check. Check for System Fault Code 4073. Replace components in the following order until engine operates properly:	a. System Fault Code 4073 does not repeat.	a. Return engine to service.
	• FTIT Probes 2,4, and 6 • DEEC • Temperature Cable	b. System Fault Code 4073 repeats.	b. Replace next component and repeat steps 3 and 4.

6. SYSTEM FAULT CODE 4074: EDU FTIT EXCEEDS SCHEDULED LIMIT.
(See figure 1 and Figure 2 and Table 5.)

a. Cause of Fault:

(1) EDU sensed FTIT exceeded DEEC FTIT scheduled limit by more than 32°F (17.8°C).

b. Engine Symptoms:

(1) None

c. Test Cell Observations:

(1) High indicated FTIT

(2) SYSTEM FAULT light ON

Table 5. System Fault Code 4074: EDU FTIT Exceeds Scheduled Limit

Step	Procedure	Result	Corrective Action
1.	Review event data per WP 651 00 for Event Code 1070 - FTIT Overtemperature. Compare data to engine operating limits per WP 205 00.	a. Event Code 1070 not present. b. Event Code 1070 present.	a. Go to step 2. b. Perform resistance check per system Fault Code 4074, then troubleshoot Event Code 1070.
2.	Review event and fault data for FTIT faults per WP 651 00.	a. FTIT events or faults present. b. No FTIT events or faults present.	a. Troubleshoot FTIT events or faults per WP 501 00. b. Go to step 3.
3.	Perform following resistance checks per figure 1.		
	a. CONN P81 PINS 1. T to X 2. U to X 3. V to X 4. W to X	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace temperature cable per WP 501 00.
	b. CONN P81 PINS 1. T to U 2. U to GND 3. T to GND 4. V to W 5. V to GND 6. W to GND	b.1. Resistance checks within limits: 1. LT 20 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. LT 20 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	b.1. Go to c.
		b.2. Resistance checks out of limits.	b.2. Go to step 5.

Table 5. System Fault Code 4074: EDU FTIT Exceeds Scheduled Limit (continued)

Step	Procedure	Result	Corrective Action
3. (cont'd)	Disconnect P38 through P44. Perform following resistance checks per figure 1.		
	c. CONN PINS P81 1. T to U 2. V to W	c.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	c.1. Go to d.
		c.2. Resistance checks out of limits.	c.2. Replace temperature cable per WP 501 00.
	d. CONN PINS J38 to J44 1. A to D 2. B to C 3. A to C 4. B to D 5. A to GND 6. B to GND 7. C to GND 8. D to GND	d.1. Resistance checks within limits: 1. LT 5 OHMS 2. LT 5 OHMS 3. GT 750,000 OHMS 4. GT 750,000 OHMS 5. GT 750,000 OHMS 6. GT 750,000 OHMS 7. GT 750,000 OHMS 8. GT 750,000 OHMS	d.1. Go to step 4.
		d.2. Resistance checks out of limits.	d.2. Replace out of limit FTIT probe per WP 501 00, then go to step 6.
4.	Reconnect P38 through P44. Perform following resistance checks per figure 2.		
	a. CONN PINS P48 1. 1 to 9 2. 2 to 9 3. 3 to 9 4. 4 to 9 5. 5 to 9 6. 6 to 9 7. 7 to 9 8. 8 to 9	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS 8. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace temperature cable per WP 501 00.

Table 5. System Fault Code 4074: EDU FTIT Exceeds Scheduled Limit (continued)

Step	Procedure	Result	Corrective Action
4. (cont'd)	b. CONN PINS P48 1. 1 to 8 2. 2 to 8 3. 3 to 8 4. 4 to 8 5. 5 to 8 6. 6 to 8 7. 7 to 8 8. 8 to GND	b.1. Resistance checks within limits: 1. LT 20 OHMS 2. LT 20 OHMS 3. LT 20 OHMS 4. LT 20 OHMS 5. LT 20 OHMS 6. LT 20 OHMS 7. LT 20 OHMS 8. GT 100,000 OHMS	b.1. Go to step 6.
		b.2. Resistance checks out of limits.	b.2. Replace temperature cable per WP 501 00.
5.	If any resistance checks in steps 3.b.1. through 3.b.3. (FTITA) are out of limits, perform resistance checks on probes 1, 3, 5, and 7 per figure 1 as follows:		
	a. CONN PINS J38, J40, J42, J44 1. A to D 2. B to C 3. A to C 4. B to D 5. A to GND 6. B to GND 7. C to GND 8. D to GND	a.1. Resistance checks within limits: 1. LT 5 OHMS 2. LT 5 OHMS 3. GT 750,000 OHMS 4. GT 750,000 OHMS 5. GT 750,000 OHMS 6. GT 750,000 OHMS 7. GT 750,000 OHMS 8. GT 750,000 OHMS	a.1. Replace temperature cable per WP 501 00, then go to step 6.
		a.2. Resistance checks out of limits.	a.2. Replace out of limit FTIT probe per WP 501 00, then go to step 6.

Table 5. System Fault Code 4074: EDU FTIT Exceeds Scheduled Limit (continued)

Step	Procedure	Result	Corrective Action
5. (cont'd)	If any resistance checks in steps 3.b.4. through 3.b.6. (FTITB) are out of limits, perform resistance checks on probes 2, 4, and 6 per figure 1 as follows:		
	b. CONN PINS J39 J41 J43 1. A to D 2. B to C 3. A to C 4. B to D 5. A to GND 6. B to GND 7. C to GND 8. D to GND	b.1. Resistance checks within limits: 1. LT 5 OHMS 2. LT 5 OHMS 3. GT 750,000 OHMS 4. GT 750,000 OHMS 5. GT 750,000 OHMS 6. GT 750,000 OHMS 7. GT 750,000 OHMS 8. GT 750,000 OHMS	b.1. Replace temperature cable per WP 501 00, then go to step 6.
		b.2. Resistance checks out of limits.	b.2. Replace out of limit FTIT probe per WP 501 00, then go to step 6.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
6.	Ensure EDU data has been reviewed and stored per WP 651 00, then clear EDU data per WP 656 00.		
7.	Perform IDLE functional check per WP 213 00 with EAU in monitor mode. Monitor FTIT parameters and compare to IDLE FTIT spread and instability limits per WP 205 00.	a. FTIT parameters out of limits: 1. Individual FTIT probes to FTITAV (word 1005) 2. FTITA (word 0056) to FTITAV (word 1005) 3. FTITB (word 0057) to FTITAV (word 1005)	a. Replace probes as follows: 1. Malfunctioning probe. 2. Probes 1, 3, 5, and 7. 3. Probes 2, 4, and 6.
		b. FTIT parameter within limits.	b. Go to step 8.

Table 5. System Fault Code 4074: EDU FTIT Exceeds Scheduled Limit (continued)

Step	Procedure	Result	Corrective Action
8.	Perform ACCEL/DECEL functional check. Monitor FTIT parameters at stabilized MIL and compare to MIL FTIT spread and instability limits per WP 205 00.	a. FTIT parameters out of limits: 1. Individual FTIT probes to FTITAV (word 1005) 2. FTITA (word 0056) to FTITAV (word 1005) 3. FTITB (word 0057) to FTITAV (word 1005)	a. Replace probes as follows: 1. Malfunctioning probe. 2. Probes 1, 3, 5, and 7. 3. Probes 2, 4, and 6. a.1. Go to step 6.
		b. FTIT parameters within limits.	b. Go to step 9.
9.	Check for System Fault Code 4074.	a. System Fault Code 4074 repeats.	a. Replace components in following order, then repeat steps 6. through 9. until engine operates properly: 1. FTIT probes 2. EDU 3. Temperature cable 4. DEEC (refer to WP 501 00). a.1. Repeat steps 6. through 9. until engine operates properly.
		b. System Fault Code 4074 does not repeat.	b. Return engine to service.

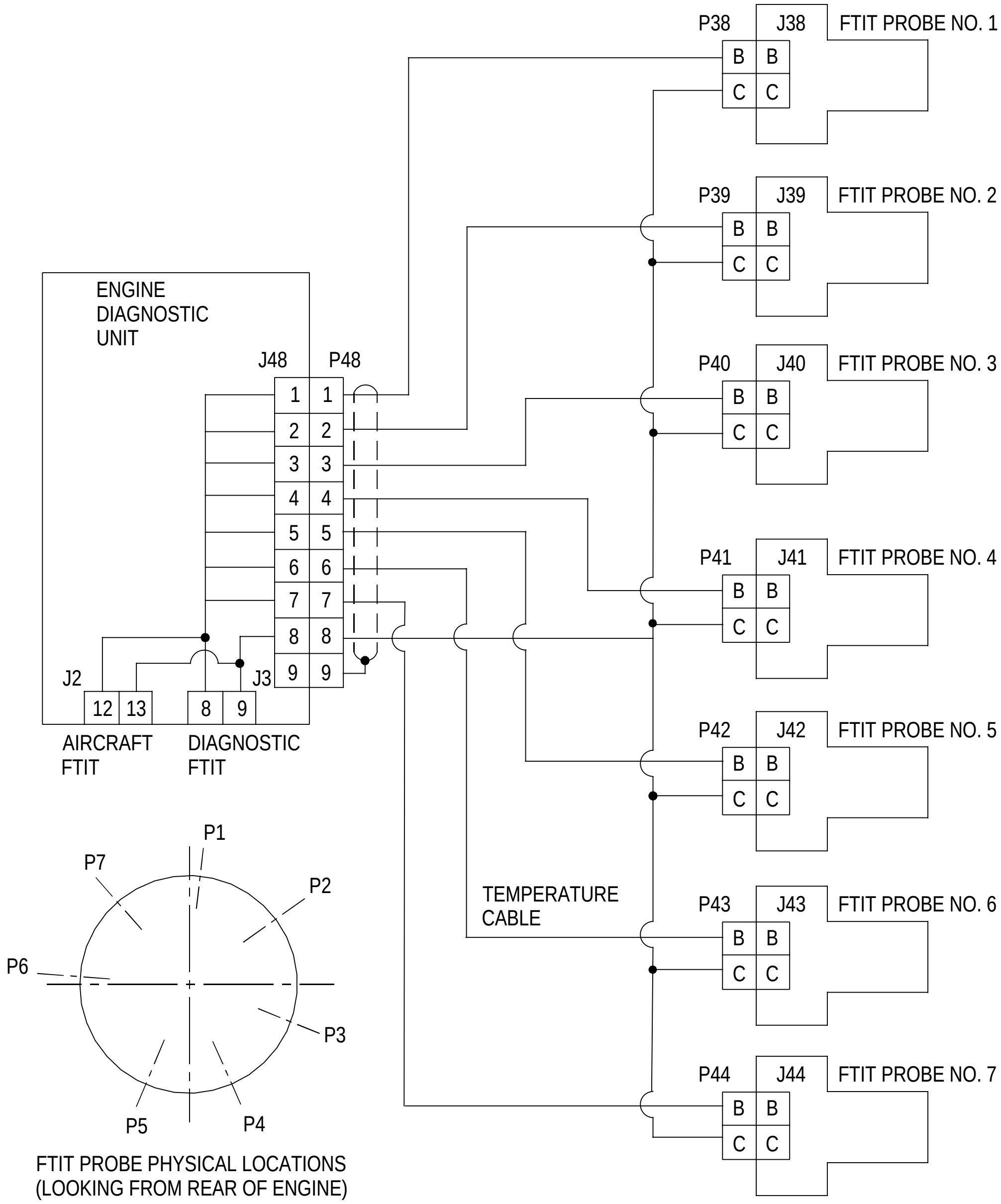
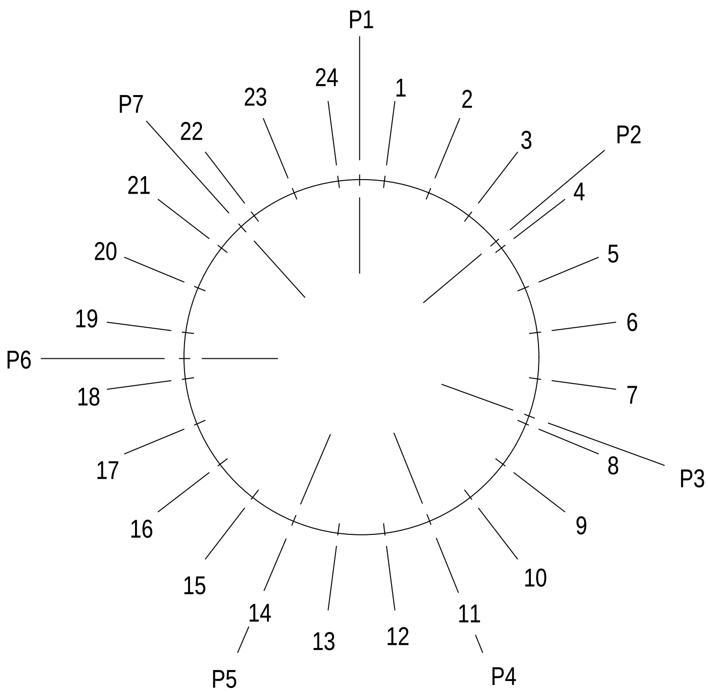


Figure 2. FTIT Indicator Circuit (Sheet 1 of 2)

DIAGRAM OF FUEL NOZZLE POSITIONS (1 THRU 24)
7 FTIT PROBES (P1 THRU P7)



NOTE

FUEL NOZZLE RELATIONSHIP TO FTIT PROBES:

FTIT PROBE POSITION	FUEL NOZZLES AFFECTING PROBE
P1	22,23,24
P2	1,2,3
P3	4,5,6,7
P4	9,10,11
P5	12,13,14
P6	16,17,18
P7	19,20,21

96741 (36X2)

Figure 2. FTIT Indicator Circuit (Sheet 2 of 2)

7. SYSTEM FAULT CODE 4075: MULTIPLE FTIT PROBE MALFUNCTION.

(See Figure 2 and Table 6.)

a. Cause of Fault:

(1) Three or more FTIT probes fail signal range or response test (Refer to EDU Advisory Fault Codes 5011-5017).

b. Engine Symptoms:

(1) Erroneous FTIT values may cause different Intermediate (MIL) operating point if FTIT borders the –74° to 2499°F (–58° to 1371°C) range.

c. Test Stand Observations:

(1) System fault light ON

(2) Erroneous FTIT readings

Table 6. System Fault Code 4075: Multiple FTIT Probe Malfunction

Step	Procedure	Result	Corrective Action
1.	Review fault and event data for EDU Advisory Fault Codes 5011-5017.	a. EDU Advisory Fault Codes 5011-5017 present. b. EDU Advisory Fault Codes 5011-5017 not present.	a. Troubleshoot advisory fault codes as required. b. Go to step 2.
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform primary functional check. Check for system Fault Code 4075. Replace components in the following order until engine operates properly. • Suspect FTIT probes • EDU • Temperature cable	a. System Fault Code 4075 does not repeat. b. System Fault Code 4075 repeats.	a. Return engine to service. b. Replace next component and repeat steps 2. and 3.

SUBORDINATE WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4076 - 4077: EDU VS DEEC FTIT OUT OF LIMITS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE SWP PAGES

Total Number of Pages in this SWP is 14

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 14	23				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00
IDLE Functional Check	WP 216 00
Engine Shutdown	WP 225 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	EDU FAULT CODE 4076: EDU vs DEEC FTITA OUT OF LIMITS	
	VOLT/OHMMETER	PSM-6 OR EQUIVALENT
3	EDU FAULT CODE 4077: EDU vs DEEC FTITB OUT OF LIMITS	
	VOLT/OHMMETER	PSM-6 OR EQUIVALENT

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This subordinate work package contains troubleshooting procedures for FTIT system faults 4076 and 4077.

2. EDU FAULT CODE 4076: EDU VS DEEC FTITA OUT OF LIMITS.

(See Figures 1, 2, and 3 and Table 1.)

a. Cause of Fault:

(1) EDU FTITA exceeds DEEC FTITA sensor values by more than 50°F (28°C).

b. Engine Symptoms:

(1) None.

c. Test Stand Observation:

(1) None.

d. Data Collected:

(1) NDELATM - Time at DEEC negative FTITA delta.

(2) Normal operating signals will be displayed as is.

(3) Time of occurrence.

Table 1. System Fault Code 4076: EDU vs DEEC FTITA Out Of Limits

Step	Procedure	Result	Corrective Action
1.	Review fault and event data for other FTIT faults and advisories.	a. Other FTIT faults present. b. No other FTIT faults present.	a. Troubleshoot other individual faults. b. Go to step 2.
2.	Check FTIT circuit. Remove P48 from J48 on EDU and P81 from J81 on DEEC. Perform resistance checks as follows: (See figures 1, 2, and 3.)		
	a. CONN P48 PINS 1. 1 to 9 2. 3 to 9 3. 5 to 9 4. 7 to 9 5. 8 to 9	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace temperature cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 4.

Table 1. System Fault Code 4076: EDU vs DEEC FTITA Out Of Limits (continued)

Step	Procedure	Result	Corrective Action
2.	(continued)		
	b. CONN P48 PINS	b.1. Resistance checks within limits:	b.1. Go to c.
	1. 1 to 8	1. LT 20 OHMS	
	2. 3 to 8	2. LT 20 OHMS	
	3. 5 to 8	3. LT 20 OHMS	
	4. 7 to 8	4. LT 20 OHMS	
	5. 8 to GND	5. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Go to e. and perform resistance check on probe connectors for out of limit probes. Check Probe Connector 1 1 J38 2 3 J40 3 5 J42 4 7 J44
	c. CONN P81 PINS	c.1. Resistance checks within limits:	c.1. Go to d.
	1. T to X	1. GT 100,000 OHMS	
	2. U to X	2. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Replace temperature cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 3.
	d. CONN P81 PINS	d.1. Resistance checks within limits:	d.1. Connect connectors P48 and P81. Go to step 3.
	1. T to U	1. LT 20 OHMS	
	2. U to GND	2. GT 100,000 OHMS	
	3. T to GND	3. GT 100,000 OHMS	
		d.2. Resistance checks out of limits.	d.2. Go to e.

Table 1. System Fault Code 4076: EDU vs DEEC FTITA Out Of Limits (continued)

Step	Procedure	Result	Corrective Action
2.	(continued) e. CONN J38, J40, J42, and J44 — PINS 1. A to D 2. B to C 3. A to C 4. A to GND 5. B to GND	e.1. Resistance checks within limits: 1. LT 5 OHMS 2. LT 5 OHMS 3. GT 750,000 OHMS 4. GT 750,000 OHMS 5. GT 750,000 OHMS	e.1. Replace temperature cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 3.
		e.2. Resistance checks out of limits.	e.2. Replace FTIT probes with out of limits resistance. Refer to T.O. 2J-F100-53-4, WP 008 00. Go to step 3.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored per WP 651 00, then clear EDU data per WP 656 00. Go to step 4.		
4.	Perform IDLE functional check per WP 216 00. Perform EDU Real-Time monitor per WP 653 00. Monitor FTIT1, FTIT3, FTIT5, FTIT7, and FTITAV, check overall limits and FTIT spread per WP 205 00.	a. FTIT parameters within limits.	a. Go to step 5.
		b.1. Individual FTIT probes out of limits.	b.1. Replace malfunctioning probes. Refer to T.O. 2J-F100-53-4, WP 008 00. Go to step 5.
		b.2. FTIT spread out of limits.	b.2. Record FTIT spread and go to step 5.

Table 1. System Fault Code 4076: EDU vs DEEC FTITA Out Of Limits (continued)

Step	Procedure	Result	Corrective Action
5.	Stablilize engine at IDLE for 9 minutes. Accel to Intermediate (MIL) and stabilize for 3 minutes. Monitor FTIT parameters and compare to MIL FTIT spread and stability limits per WP 205 00.	a. FTIT parameters within limits. b.1. FTIT individual probe(s) out of limits. b.2. FTIT spread out of limits.	a. Go to step 6. b.1. Replace malfunctioning probes. Refer to T.O. 2J-F100-53-4, WP 008 00. b.1. Troubleshoot per WP 542 00.
6.	Perform engine shutdown per WP 225 00. Review EDU data for fault codes per WP 651 00.	a. System fault code 4076 or advisory code 5009 does not repeat. b. System fault code 4076 or advisory code 5009 repeats.	a. Return engine to service. b. Replace components in following order, one at a time and go to step 3. • FTIT probes 1, 3, 5, and 7. Refer to T.O. 2J-F100-53-4, WP 008 00. • DEEC. Refer to T.O. 2J-F100-53-4, WP 007 00. • EDU. Refer to T.O. 2J-F100-53-4, WP 023 00. • Temperature cable. Refer to T.O. 2J-F100-53-4, WP 019 00.
7.	Clear EDU data per WP 656 00.		

3. EDU FAULT CODE 4077:
EDU VS DEEC FTITB OUT OF LIMITS.
(See figures 1, 2, and 3 and Table 2.)

a. Cause of Fault:

(1) EDU FTITB exceeds DEEC FTITB sensor values by more than 50°F (28°C).

b. Engine Symptoms:

(1) None.

c. Test Stand Observations:

(1) None.

d. EDU Data Collected:

(1) NDELBTM - Time at DEEC negative FTITB delta.

(2) Normal operating signals will be displayed as is.

(3) Time of occurrence.

Table 2. System Fault Code 4077: EDU vs DEEC FTITB Out Of Limits

Step	Procedure	Result	Corrective Action
1.	Review fault and event data for other FTIT faults and advisories.	a. Other FTIT faults present. b. No other FTIT faults present.	a. Troubleshoot other individual faults. b. Go to step 2.
2.	Check FTIT circuit. Remove P48 from J48 on EDU and P81 from J81 on DEEC. Perform resistance checks as follows: (See figures 1, 2, and 3.) a. CONN P48 — PINS 1. 2 to 9 2. 4 to 9 3. 6 to 9 4. 8 to 9	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS a.2. Resistance checks out of limits.	a.1. Go to b. a.2. Replace temperature cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 3.

Table 2. System Fault Code 4077: EDU vs DEEC FTITB Out Of Limits (continued)

Step	Procedure	Result	Corrective Action
2.	(continued)		
	b. CONN P48 PINS 1. 2 to 8 2. 4 to 8 3. 6 to 8 4. 8 to GND	b.1. Resistance checks within limits: 1. LT 20 OHMS 2. LT 20 OHMS 3. LT 20 OHMS 4. GT 100,000 OHMS	b.1. Go to c.
		b.2. Resistance checks out of limits.	b.2. Go to e. and perform resistance check on probe connectors out of limits. Step Probe Connector 1 2 J39 2 4 J41 3 6 J43
	c. CONN P81 PINS 1. V to X 2. W to X	c.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	c.1. Go to d.
		c.2. Resistance checks out of limits.	c.2. Replace temperature cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 3.
	d. CONN P81 PINS 1. V to W 2. V to GND 3. W to GND	d.1. Resistance checks within limits: 1. LT 20 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	d.1. Connect connector P48 and P81. Go to step 3.
		d.2. Resistance checks out of limits.	d.2. Go to e.

Table 2. System Fault Code 4077: EDU vs DEEC FTITB Out Of Limits (continued)

Step	Procedure	Result	Corrective Action
2.	(continued)		
	e. CONN J39, J41, and J43 PINS	e.1. Resistance checks within limits:	e.1. Replace temperature cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 3.
	1. A to D	1. LT 5 OHMS	
	2. B to C	2. LT 5 OHMS	
	3. A to C	3. GT 750,000 OHMS	
	4. A to GND	4. GT 750,000 OHMS	
	5. B to GND	5. GT 750,000 OHMS	
		e.2. Resistance checks out of limits.	e.2. Replace FTIT probes with out of limits resistance. Refer to T.O. 2J-F100-53-4, WP 008 00. Go to step 3.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

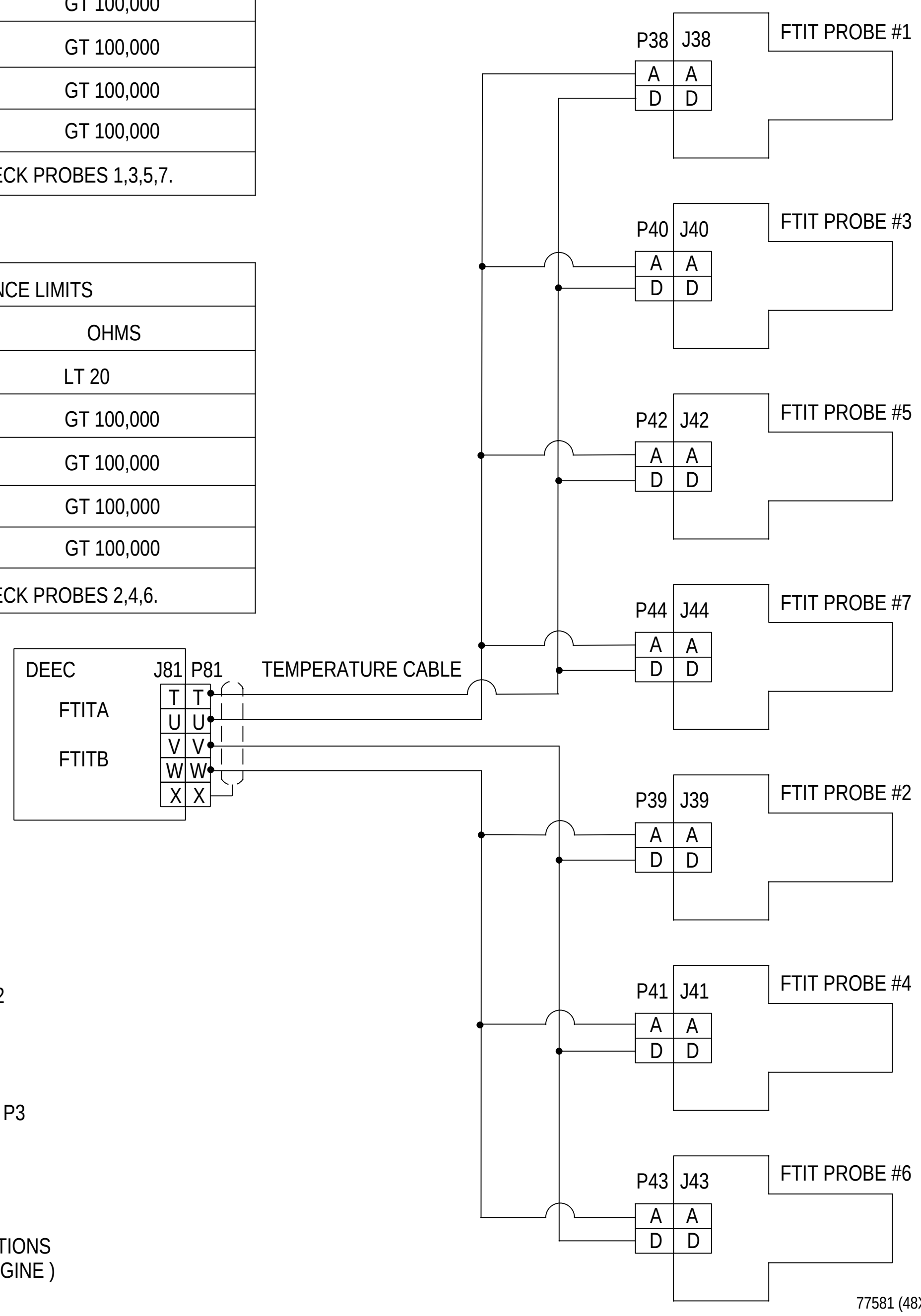
Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored per WP 651 00, then clear EDU data per WP 656 00. Go to step 4.		
4.	Perform IDLE functional check per WP 216 00. Perform EDU Real-Time monitor per WP 653 00. Monitor FTIT2, FTIT4, FTIT6, and FTITAV, check overall limits and FTIT spread per WP 205 00.	a. FTIT parameters within limits.	a. Go to step 5.
		b.1. Individual FTIT probes out of limits.	b.1. Replace malfunctioning probes. Refer to T.O. 2J-F100-53-4, WP 008 00. Go to step 5.
		b.2. FTIT spread out of limits.	b.2. Record FTIT spread and go to step 5.

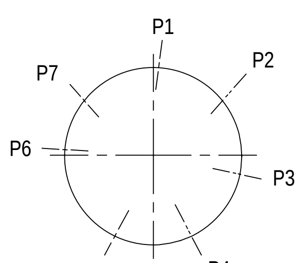
Table 2. System Fault Code 4077: EDU vs DEEC FTITB Out Of Limits (continued)

Step	Procedure	Result	Corrective Action
5.	Stabilize engine at IDLE for 9 minutes. Accel to Intermediate (MIL) and stabilize for 3 minutes. Monitor FTIT parameters and compare to FTIT spread and stability limits per WP 205 00.	a. FTIT parameters within limits. b.1. FTIT individual probes out of limits. b.2. FTIT spread out of limits.	a. Go to step 6. b.1. Replace individual malfunctioning probes. Refer to T.O. 2J-F100-53-4, WP 008 00. b.2. Troubleshoot per WP 542 00.
6.	Perform engine shutdown per WP 225 00. Review EDU data for fault codes per WP 651 00.	a. System fault code 4077 or advisory fault code 5010 does not repeat. b. System fault code 4077 or advisory fault code 5010 repeats.	a. Return engine to service. b. Replace components in following order, one at a time and go to step 3. • FTIT probes 2, 4, and 6. Refer to T.O. 2J-F100-53-4, WP 008 00. • DEEC. Refer to T.O. 2J-F100-53-4, WP 007 00. • EDU. Refer to T.O. 2J-F100-53-4, WP 023 00. • Temperature cable. Refer to T.O. 2J-F100-53-4, WP 019 00.
7.	Clear EDU data per WP 656 00.		

FTITA RESISTANCE LIMITS	
PINS (P81)	OHMS
T TO U	LT 20
U TO GND	GT 100,000
T TO GND	GT 100,000
T TO X	GT 100,000
U TO X	GT 100,000
IF P81 CHECKS OUT OF LIMITS, CHECK PROBES 1,3,5,7.	

FTITB RESISTANCE LIMITS	
PINS (P81)	OHMS
V TO W	LT 20
V TO GND	GT 100,000
W TO GND	GT 100,000
V TO X	GT 100,000
W TO X	GT 100,000
IF P81 CHECKS OUT OF LIMITS, CHECK PROBES 2,4,6.	





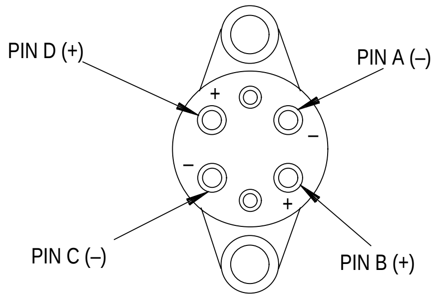
FTIT PROBE PHYSICAL LOCATIONS
(LOOKING FROM REAR OF ENGINE)

77581 (48X2)

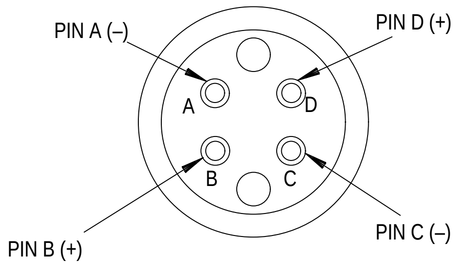
Figure 1. DEEC FTITA and FTITB Probe Circuits

NOTE

VERIFY FTIT PROBE PIN DESIGNATIONS BY COMPARING THEM TO LETTERED PINS IN HARNESS CAP



FTIT PROBE – TOP VIEW



FTIT HARNESS CAP – INSIDE VIEW

RESISTANCE LIMITS AT FTIT PROBE		
CONNECTORS	PINS	OHMS
J38 THRU J44	B TO C	LT 5
	B TO GND	GT 750,000
	A TO D	LT 5
	A TO GND	GT 750,000
	A TO C	GT 750,000

75106 (36X2)

Figure 2. FTIT Probe Circuits

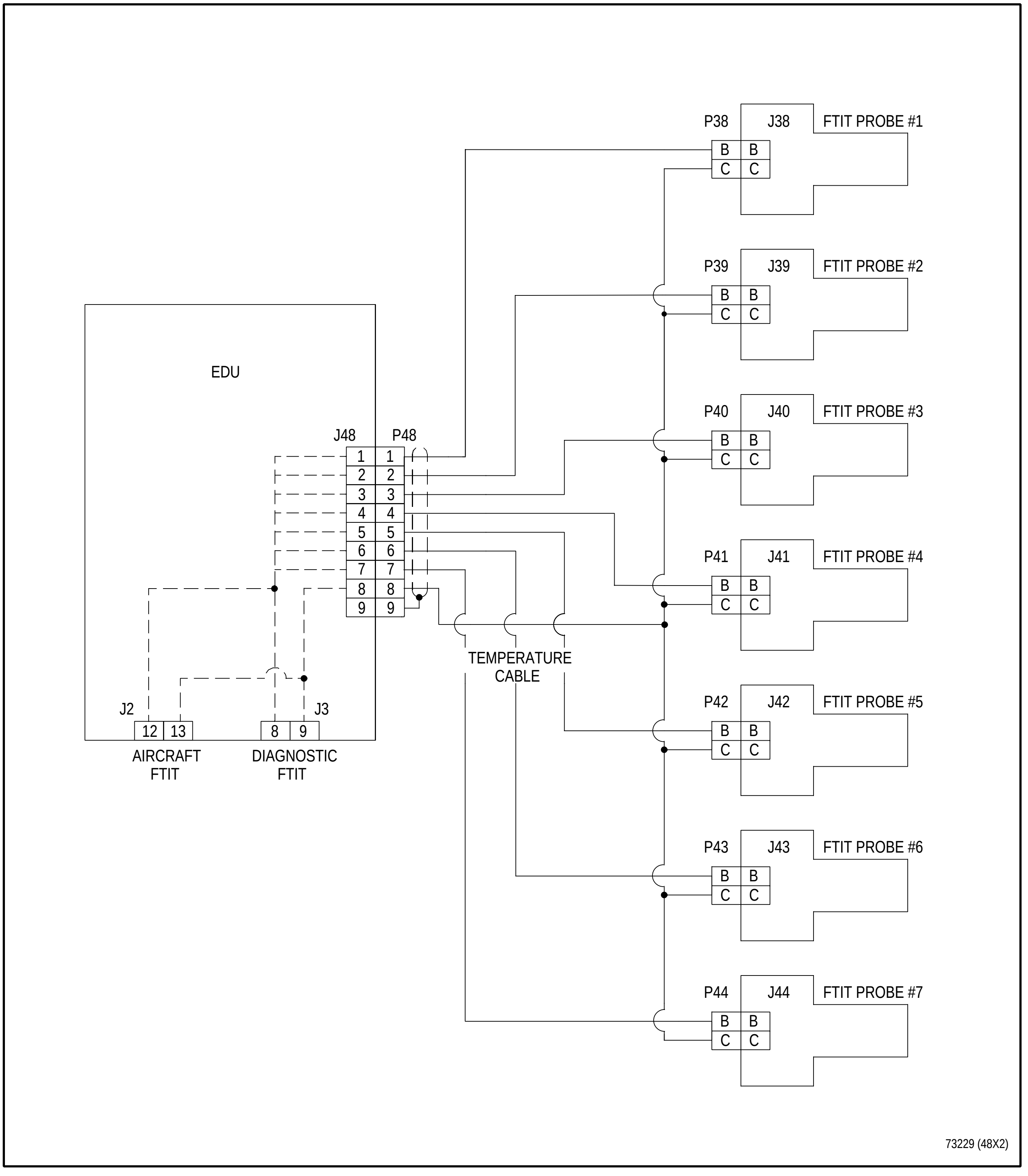


Figure 3. EDU FTIT Indicator Circuit (Sheet 1 of 2)

FTIT INDICATOR CIRCUIT RESISTANCE LIMITS		
	P48	OHMS
ALL PROBES	8–GND AND 8–9	GT 100,000
PROBE 1	1–8	LT 20
PROBE 2	2–8	LT 20
PROBE 3	3–8	LT 20
PROBE 4	4–8	LT 20
PROBE 5	5–8	LT 20
PROBE 6	6–8	LT 20
PROBE 7	7–8	LT 20
PROBE 1	1–9	GT 100,000
PROBE 2	2–9	GT 100,000
PROBE 3	3–9	GT 100,000
PROBE 4	4–9	GT 100,000
PROBE 5	5–9	GT 100,000
PROBE 6	6–9	GT 100,000
PROBE 7	7–9	GT 100,000

98528 (36X2)

Figure 3. EDU FTIT Indicator Circuit (Sheet 2 of 2)

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4080 - 4083:
N1 SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 16

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REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Acceleration/Deceleration Check Procedures	WP 210 00
Engine Troubleshooting - General	WP 501 00
EDU Test Procedures Using EAU	WP 650 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedures Using EAU	WP 652 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
Main Fuel Pump Fuel Pressure Analysis	WP 661 00
Inlet/Fan Module	T.O. 2J-F100-53-6
Compressor Inlet Variable Vane Cylinder System Rigging	WP 705 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
3	System Fault Code 4081: N1A and N1B Speed Signal Out of Limits	
	Ohmmeter	PSM-6 or equivalent
4	System Fault Code 4082: N1 Speed Signals Out of Range	
	Ohmmeter	PSM-6 or equivalent

APPLICABLE SUPPORT EQUIPMENT (continued)

Paragraph	Function - Tool Nomenclature	Tool Number
5	System Fault Code 4083: EDU N1D Speed Signal Out of Range	
	Ohmmeter ------------------------------	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for N_1 system.

b. Several configurations of DEEC software are currently in use. Fault detection logic and troubleshooting methods vary with DEEC configurations. Documentary data (DEEC ID) determines configuration of DEEC software involved.

2. SYSTEM FAULT CODE 4080: N_1 OVERSPEED.

(See Table 1.)

a. Cause of Fault:

(1) N_1exceeds or is predicted to exceed the DEEC's N_1.maximum limit and the EDU did not detect an N_1 overspeed exceeding the structural limit, 1080 event. The DEEC predicts an N_1 overspeed by determining present N_1 rpm and N_1 rpm rate of increase. The actual DEEC N_1 overspeed limit ranges from 10,500 to 11,650, based on TT2 (11,580 at 80°F).

b. Engine Symptoms:

(1) Transfer to SEC mode

c. Test Cell Observations:

(1) SEC caution light on

(2) System fault light on

(3) Event code 1200: Auto transfer to SEC mode

Table 1. System Fault Code 4080:
N1 Overspeed

Step	Procedure	Result	Corrective Action

CAUTION

If maximum N1 rpm exceeded 12,400, do not operate engine.

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Other events or faults are present.	a. Troubleshoot individual event or fault codes.
		b. No other events or faults are present.	b. Go to step 2.
2.	Perform the CIVV functional checks.	a. CIVV system functional.	a. Go to step 3.
		b. CIVV system does not function properly.	b. Repair CIVV system parts as required.
3.	Perform main fuel pump fuel pressure analysis.	a. Fuel pressures out of limits.	a. Replace component as required per MFP. Fuel pressure analysis.
		b. Fuel pressures within limits.	b. Go to step 4.

Table 1. System Fault Code 4080: N1 Overspeed (continued)

Step	Procedure	Result	Corrective Action
4.	Perform primary mode engine start. With engine at IDLE, cycle exhaust nozzle reset switch (RESET-OFF-RESET).	a. Exhaust nozzle operates properly.	a. Go to step 5.
		b. Exhaust nozzle binds or hesitates.	b. Repair nozzle actuation component parts as required.
5.	a. Check DEEC pressure transducers. Start engine and move throttle to intermediate (MIL). Stabilize 3 minutes. Compare Pt6, Pb and Ps2 values between EAU and test cell instrumentation.	a. Values within limits: 1. Pt6 within ±1.0 in.HgA. 2. Pb within ±5.0 psia. 3. Ps2 stand - Ps2EAU=0.0-0.4 in HgA	a. Go to step 6.
	b. Move throttle to IDLE and shut down engine after test is complete.	b. Pt6, Pb, or Ps2 value out-of-limits.	b. Repair as required.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
6.	Check that EDU data has been reviewed and stored; then clear EDU data.		
7.	Perform accel/decel functional check. Check for System Fault Code 4080. Replace components in the following order until engine operates properly: • CENC EHV • CENC • CIVV EHV • CIVV Control and Cylinder • DEEC • MFP	a. System Fault Code 4080 does not repeat. b. System Fault Code 4080 repeats.	a. Return engine to service. b. Replace next component and repeat steps 6 and 7.

3. SYSTEM FAULT CODE 4081: N1A AND/OR N1B SPEED SIGNAL OUT OF RANGE. (See Figures 1 and 2, and Table 2.)

a. Cause of Fault:

(1) N1A and/or N1B speed signals out of 1400 to 17,500 rpm range

(2) N1A and N1B speed signals differ by more than 50 rpm.

b. Engine Symptoms:

(1) If in-range N1 sensor values differ by more than 50 rpm, higher value is used. No effect on engine operation.

(2) If either N1 sensor value exceeds range, other sensor value used. No effect on engine operation.

(3) If both N1 sensor values exceed range, engine transfers to SEC mode.

c. Test Cell Observations (Either speed signal (N1A or N1B) Malfunctions):

(1) System fault light on

d. Additional Test Cell Observations (Both speed signals (N1A and N1B) malfunction):

(1) SEC caution light on

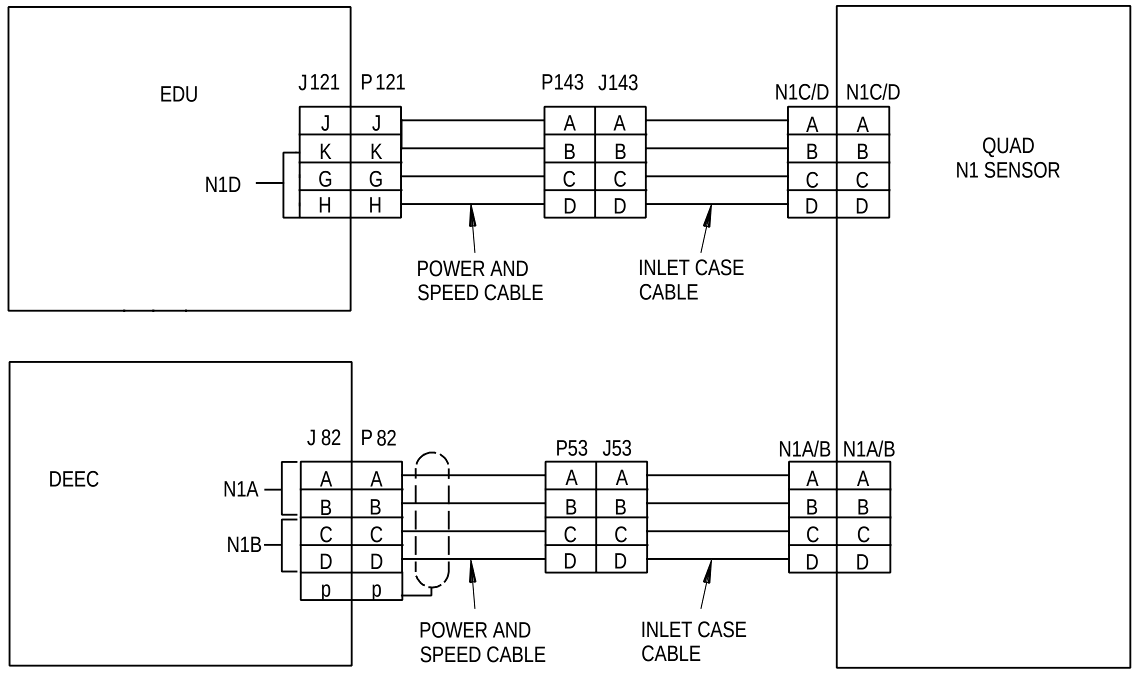
(2) EDU Event Code 1200: Auto transfer to SEC mode

Table 2. System Fault Code 4081:
N1A and/or N1B Speed Signal Out Of Range

Step	Procedure	Result	Corrective Action
1.	Perform the following resistance checks. See figure 1.		
	a. CONN P82 PINS 1. A to p 2. C to p	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable.
	b. CONN P82 PINS 1. A to B 2. C to D 3. A to C 4. A to GND 5. C to GND	b.1. Resistance checks within limits: 1. 38 to 58 OHMS 2. 38 to 58 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Disconnect P53 from fan inlet case. Go to c.
	c. CONN J53 PINS 1. A to B 2. C to D 3. A to C 4. A to GND 5. C to GND	c.1. Resistance checks within limits: 1. 38 to 58 OHMS 2. 38 to 58 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	c.1. Replace power and speed cable.
		c.2. Resistance checks out of limits.	c.2. Remove outer anti-icing cone. Disconnect N1A/B connector from N1 sensor. See figure 2. Go to d.
	d. CONN N1A/B PINS 1. A to B 2. C to D 3. A to C 4. A to GND 5. C to GND	d.1. Resistance checks within limits: 1. 38 to 58 OHMS 2. 38 to 58 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	d.1. Replace fan inlet case N1 cable.
		d.2. Resistance checks out of limits.	d.2. Replace quad N1 sensor.

**Table 2. System Fault Code 4081:
N1A and/or N1B Speed Signal Out Of Range (continued)**

Step	Procedure	Result	Corrective Action
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform IDLE functional check. Check for System Fault Code 4081. Replace components in the following order until engine operates properly: • DEEC • Fan inlet case N1 cable • N1 sensor • Power and speed cable	a. System Fault Code 4081 does not repeat. b. System Fault Code 4081 repeats.	a. Return engine to service. b. Replace next component and repeat steps 2 and 3.



N1A/B RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P82	A-B	38-58
	C-D	38-58
	A-C	GT 100,000
	A-GND	GT 100,000
	C-GND	GT 100,000
	A-p	GT 100,000
	C-p	GT 100,000
J53	A-B	38-58
	C-D	38-58
	A-C	GT 100,000
	A GND	GT 100,000
	C-GND	GT 100,000
N1A/B	A-B	38-58
	C-D	38-58
	A-C	GT 100,000
	A-GND	GT 100,000
	C-GND	GT 100,000

N1C/D RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P121	G-H	174-234
	G-GND	GT 100,000
	H-GND	GT 100,000
J143	C-D	174-234
	C-GND	GT 100,000
N1C/D	C-D	174-234
	C-GND	GT 100,000

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Figure 1. N1 - (A, B, C, and D) Signal Circuit

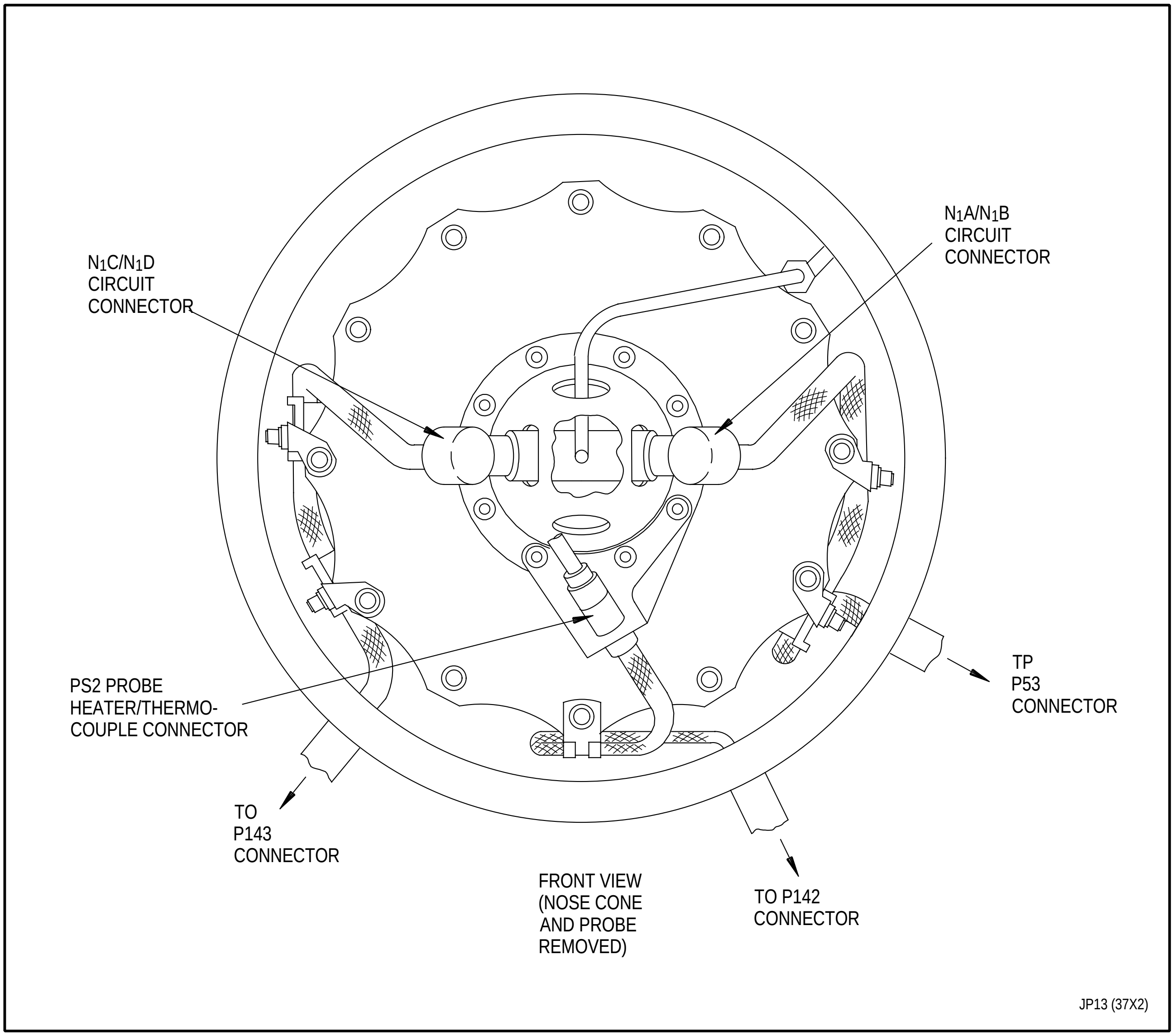


Figure 2. Nose Cone - Electrical Connections

4. SYSTEM FAULT CODE 4082: N1 SPEED SIGNALS OUT OF RANGE.
(See figures 1 and 2, and Table 3.)

a. Cause of Fault:

(1) N1A and/or N1B signals to DEEC out of 1400 to 17,500 rpm range

(2) N1A and N1B signals to DEEC out of range and N1D signal to EDU out of range. Normal range is 1400 to 17,500 rpm.

b. Engine Symptoms:

(1) None

(2) Transfer to SEC mode if N1A and N1B signals malfunction

c. Test Cell Observations:

(1) SEC caution light on if N1A and N1B signals malfunction

(2) System fault light on

(3) EDU Event Code 1200: Auto transfer to SEC if N1A and N1B signals malfunction

Table 3. System Fault Code 4082: N1 Speed Signals Out Of Range

Step	Procedure	Result	Corrective Action
1.	Inspect power and speed cable connections to inlet fan case connectors J53 and J143. Disconnect P53 and P143 and check for contamination and bent or missing pins. See figure 2.	a. P53 and P143 secure with no contamination or bent pins.	a. Disconnect P82 from DEEC. Go to step 2.
		b. P53 and P143 damaged or contaminated.	b. Repair connectors and cable as required.

Table 3. System Fault Code 4082: N1 Speed Signals Out Of Range (continued)

Step	Procedure	Result	Corrective Action
2.	Check N1A/B circuits. Perform the following resistance checks. See figure 1.		
	a. CONN P82 PINS 1. A to P 2. C to P	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable.
	b. CONN P82 PINS 1. A to B 2. C to D 3. A to C 4. A to GND 5. C to GND	b.1. Resistance checks within limits: 1. 38 to 58 OHMS 2. 38 to 58 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	b.1. Go to step 3.
		b.2. Resistance checks out of limits.	b.2. Disconnect P53 from fan inlet case. Go to c.
	c. CONN J53 PINS 1. A to B 2. C to D 3. A to C 4. A to GND 5. C to GND	c.1. Resistance checks within limits: 1. 38 to 58 OHMS 2. 38 to 58 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	c.1. Replace power and speed cable.
		c.2. Resistance checks out of limits.	c.2. Remove outer anti-icing cone. Disconnect N1A/B connector from N1 sensor. See figure 2. Go to d.
	d. CONN N1A/B PINS 1. A to B 2. C to D 3. A to C 4. A to GND 5. C to GND	d.1. Resistance checks within limits: 1. 38 to 58 OHMS 2. 38 to 58 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	d.1. Replace fan inlet case N1 cable.
		d.2. Resistance checks out of limits.	d.2. Replace quad N1 sensor.

**Table 3. System Fault Code 4082:
N1 Speed Signals Out Of Range (continued)**

Step	Procedure	Result	Corrective Action
3.	Determine EAU/DCU ID.	a. EAU/DCU ID 1-010300 b. EAU/DCU ID 1-020100 and subsequent.	a. Go to step 4. b. Go to step 6.
4.	Check N1C/D circuits. Perform the following resistance checks.		
	a. CONN P121 PINS 1. G to H 2. G to GND	a.1. Resistance checks within limits: 1. 174 to 234 OHMS 2. GT 100,000 OHMS	a.1. Go to step 5.
		a.2. Resistance checks out of limits.	a.2. Disconnect P143 and go to b.
	b. CONN J143 PINS 1. C to D 2. C to GND	b.1. Resistance checks within limits: 1. 174 to 234 OHMS 4. GT 100,000 OHMS	b.1. Replace power and speed cable.
		b.2. Resistance checks out of limits.	b.2. Remove outer anti-icing cone. Disconnect N1 sensor cables. Go to c.
	c. CONN N1C/D PINS 1. C to D 2. C to GND	c.1. Resistance checks within limits: 1. 174 to 234 OHMS 4. GT 100,000 OHMS	c.1. Replace appropriate fan inlet case electrical N1 cable.
		c.2. Resistance checks out of limits.	c.2. Replace quad N1 sensor.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
5.	Check that EDU data has been reviewed and stored; then clear EDU data.		
6.	Perform IDLE functional check. Check for System Fault Code 4082. Replace components in the following order until engine operates properly: • DEEC • Quad N1 sensor • Fan inlet case N1 cables • Power and speed cable	a. System Fault Code 4082 does not repeat. b. System Fault Code 4082 repeats.	a. Return engine to service. b. Replae next component and repeat steps 5 and 6.

5. SYSTEM FAULT CODE 4083: EDU N1D SPEED SIGNAL OUT OF RANGE.
(See figures 1 and 2, and Table 4.)

a. Cause of Fault:

(1) N1D signal to EDU out of 800 to 17,500 rpm range

b. Engine Symptoms:

(1) None

c. Test Cell Observations:

(1) System fault light on

**Table 4. System Fault Code 4083:
EDU N1D Speed Signal Out Of Range**

Step	Procedure	Result	Corrective Action
1.	Perform the following resistance checks. See figure 1.		
	a. CONN P121 PINS 1. G to H 2. G to GND	a.1. Resistance checks within limits: 1. 174 to 234 OHMS 2. GT 100,000 OHMS	a.1. Go to step 2.
		a.2. Resistance checks out of limits.	a.2. Disconnect P143 from fan inlet case. Go to b.
	b. CONN J143 PINS 1. C to D 2. C to GND	b.1. Resistance checks within limits: 1. 174 to 234 OHMS 2. GT 100,000 OHMS	b.1. Replace power and speed cable.
		b.2. Resistance checks out of limits.	b.2. Remove outer anti-icing cone. Disconnect N1D connector from N1 sensor. See figure 2. Go to c.
	c. CONN N1D PINS 1. C to D 2. C to GND	c.1. Resistance checks within limits: 1. 174 to 234 OHMS 2. GT 100,000 OHMS	c.1. Replace fan inlet case N1 cable.
		c.2. Resistance checks out of limits.	c.2. Replace quad N1 sensor.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform IDLE functional check. Check for System Fault Code 4083. Replace components in the following order until engine operates properly: • EDU • Fan inlet case N1 cable • Quad N1 sensor • Power and speed cable	a. System Fault Code 4083 does not repeat. b. System Fault Code 4083 repeats.	a. Return engine to service. b. Replace next component and repeat steps 2 and 3.

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4090 - 4093:
N2 SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 14

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REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Operating Limits	WP 205 00
Acceleration/Deceleration Check	WP 213 00
Engine Troubleshooting - General	WP 501 00
EDU Test Procedures Using EAU	WP 650 00
Downloading and Reviewing Data Using CEDS	WP 651 00
DEEC Test Procedures Using EAU	WP 652 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
Main Fuel Pump Fuel Pressure Analysis	WP 661 00
Compressor Bleed System Functional Check	WP 667 00
Engine Accessories and Rigging Procedure	T.O. 2J-F100-53-4
Control-Push-Pull, Rear Compressor Variable Vane Feedback - Rigging	WP 102 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
3	System Fault Code 4091: N2A and/or N2B Speed Signals Out of Range	
	Ohmmeter	PSM-6 or equivalent
4	System Fault Code 4092: N2A, N2B, and N2C Speed Signals Out of Range	
	Ohmmeter	PSM-6 or equivalent
5	System Fault Code 4093: N2C Speed Signal Out of Range	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for N2 system.

b. Several DEEC software configurations are currently in use. Fault detection logic and troubleshooting methods vary with each DEEC configuration. Documentary data (DEEC ID) determines pertinent DEEC software.

2. SYSTEM FAULT CODE 4090: N2 OVERSPEED.

(See Table 1.)

a. Cause of Fault:

(1) N2 exceeds or is predicted to exceed DEEC’s maximum N2 limit (actual N2 combined with rate increase) and EDU did not detect an N2 overspeed exceeding the structural limit, 1090 event. The actual DEEC N2 overspeed limit ranges from 13,785 to 14,100 (14,100 from −100° to 320°F, TT2).

b. Engine Symptoms:

(1) Transfer to SEC mode

c. Test Cell Observations:

(1) System fault light on

(2) SEC caution light on

(3) EDU Event Code 1200: Auto transfer to SEC mode

Table 1. System Fault Code 4090:
N2 Overspeed

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Other events or faults present. b. No other events or faults present.	a. Troubleshoot individual event or fault codes. b. Go to step 2.
2.	Perform the following checks:		
a.	Check RCVV feedback cable rigging.	a.1. RCVV feedback cable rigging within limits. a.2. RCVV feedback cable rigging out of limits.	a.1. Go to b. a.2. Rig RCVV feedback cable.
b.	Perform RCVV system actuation torque check.	b.1. RCVV linkage movement normal. b.2. RCVV linkage binds or requires excessive force to actuate.	b.1. Go to step 3. b.2. Check RCVV BELL crank for looseness or excessive torque. Repair as required.
3.	Perform compressor bleed system functional check.	a. Compressor bleed system not functional. b. Compressor bleed system functional.	a. Repair bleed system as required. b. Go to step 4.
4.	Perform main fuel pump fuel pressure analysis.	a. Fuel pressure out of limits. b. Fuel pressure within limits.	a. Replace component as required per MFP fuel pressure analysis. b. Go to step 5.
5.	Perform DEEC pressure sensing analysis.	a. Pressure sensing within limits: 1.Pt6 within ±1.0 in HgA 2.Pb within ±5.0 psia 3.Ps2 stand – PS2 EAU = 0.0 to 0.4 in HgA. b. Pressure sensing out of limits.	a. Go to step 6. b. Repair as required.

Table 1. System Fault Code 4090: N2 Overspeed (continued)

Step	Procedure	Result	Corrective Action
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
6.	Check that EDU data has been reviewed and stored; then clear EDU data.		
7.	Perform accel/decel functional check and check engine operation. Check for System Fault Code 4090. Replace components in the following order until engine operates properly: • RCVV-EHV (Primary) • MFC (Secondary) • DEEC • Core Module	a. System Fault Code 4090 does not repeat. b. System Fault Code 4090 repeats.	a. Return engine to service. b. Replace the next component and repeat steps 6 and 7.

3. SYSTEM FAULT CODE 4091: N2A AND/OR N2B SPEED SIGNALS OUT OF RANGE. (See Figure 1 and Table 2.)

a. Cause of Fault:

(1) N2A and N2B speed signals from generator out of 1300 to 15,000 rpm range

(2) Difference between N2A and N2B speed signals exceeds 200 rpm.

b. Engine Symptoms:

(1) If in-range signals differ by more than 200 rpm, higher signal used. No effect on engine.

(2) If one signal out of range, DEEC uses in-range signal. No effect on engine.

(3) If both signals failed, transfer to SEC mode

c. Test Cell Observations (Either speed signal (A or B) malfunctions):

(1) System fault light on

(2) Event Code 1200: Auto transfer to SEC mode

d. Additional Test Cell Observations (Both speed signals (A and B) malfunction):

(1) SEC caution light on

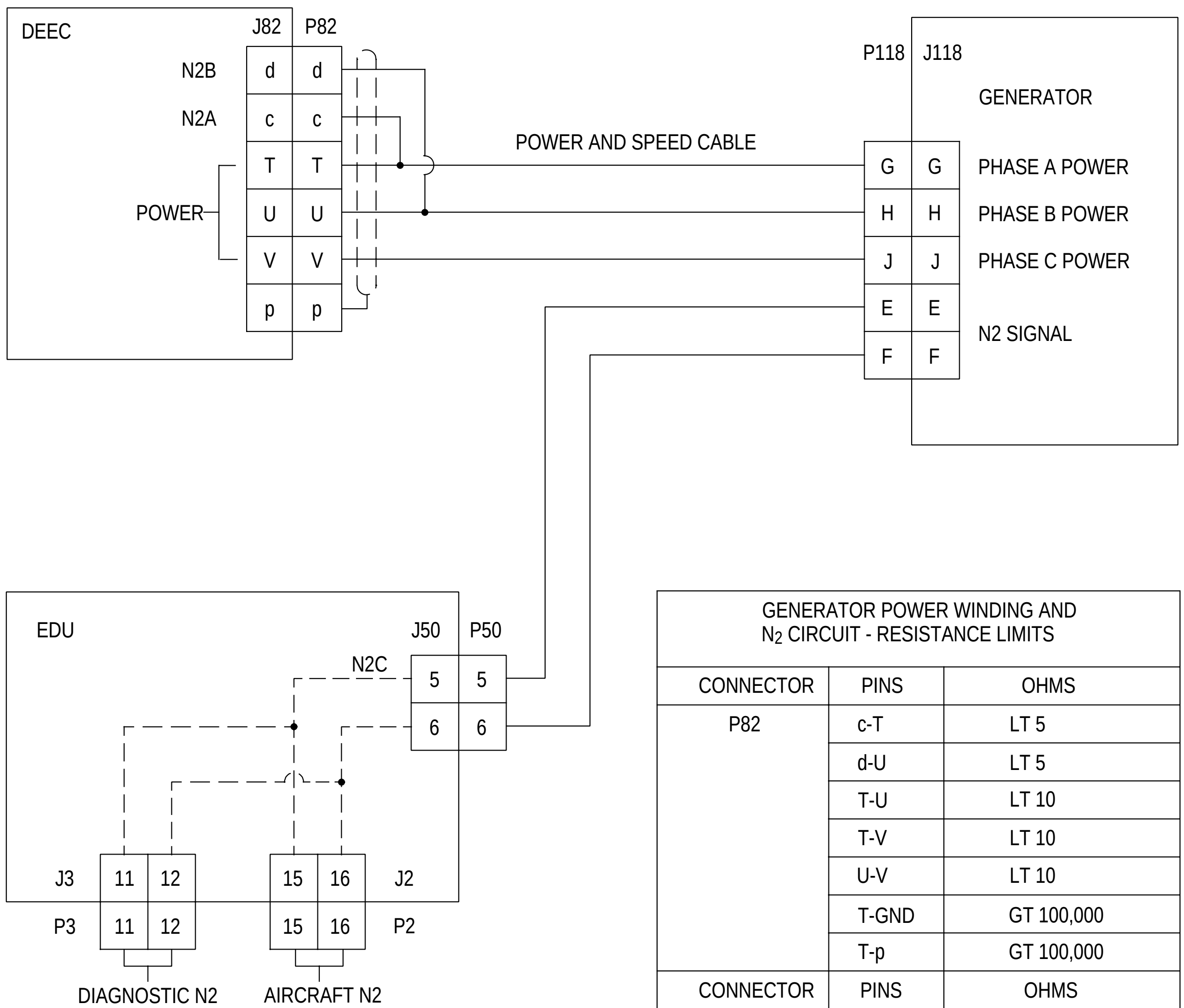
Table 2. System Fault Code 4091: N2A and/or N2B Speed Signals Out of Range

Step	Procedure	Result	Corrective Action
1.	Determine DEEC ID using EAU data review.	a. DEEC ID is 1-020402.	a. Go to step 2.
		b. DEEC ID is 1-020501 and subsequent.	b. Go to step 3.
2.	Perform the following resistance checks. See figure 1.		
	a. CONN P82 PINS 1. c to T 2. d to U 3. T to U 4. T to V 5. U to V 6. T to GND 7. T to p	a.1. Resistance checks within limits: 1. LT 5 OHMS 2. LT 5 OHMS 3. LT 10 OHMS 4. LT 10 OHMS 5. LT 10 OHMS 6. GT 100,000 OHMS 7. GT 100,00 OHMS	a.1. Go to step 3.
		a.2. Resistance checks out of limits.	a.2. Disconnect P118 from generator. Go to b.
	b. CONN J118 PINS 1. G to H 2. G to J 3. H to J 4. G to GND	b.1. Resistance checks within limits: 1. LT 10 OHMS 2. LT 10 OHMS 3. LT 10 OHMS 4. GT 100,000 OHMS	b.1. Replace power and speed cable.
		b.2. Resistance checks out of limits.	b.2. Replace generator.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored; then clear EDU data.		
4.	Perform IDLE functional check with EAU in auto search mode. Check for System Fault Code 4091. Replace components in the following order until engine operates properly:	a. System Fault Code 4091 does not repeat.	a. Return engine to service.
	• Generator Stator • DEEC • Power and Speed Cable	b. System Fault Code 4091 repeats.	b. Replace the next component and repeat steps 3 and 4.



GENERATOR POWER WINDING AND N_2 CIRCUIT - RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P82	c-T	LT 5
	d-U	LT 5
	T-U	LT 10
	T-V	LT 10
	U-V	LT 10
	T-GND	GT 100,000
	T-p	GT 100,000
CONNECTOR	PINS	OHMS
J118	G-H	LT 10
	G-J	LT 10
	H-J	LT 10
	G-GND	GT 100,000

GENERATOR N2C SIGNAL RESISTANCE LIMITS		
PINS (P50)	PINS (J118)	OHMS
5-6	E-F	750-1200
5-GND	E-GND	GT 100,000

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Figure 1. Generator Power Winding and N2 Circuit

4. SYSTEM FAULT CODE 4092: N2A, N2B, AND N2C SPEED SIGNALS OUT OF RANGE. (See figure 1, and Table 3.)

a. Cause of Fault:

(1) N2A and/or N2B signals to DEEC from generator out of 1300 to 15,000 rpm range

(2) N2A and N2B signals out of range with N2C signal to EDU; N2C signal, out of 1300 to 17,000-rpm range

b. Engine Symptoms:

(1) No engine effect if one signal malfunctions

(2) Transfer to SEC mode if both speed signals malfunction

c. Test Cell Observations (Either speed signal (A or B) malfunctions):

(1) System fault light on

d. Additional Test Cell Observations (Both speed signals (A and B) malfunction):

(1) SEC caution light on

(2) Event Code 1200: Auto transfer to SEC mode

e. Additional Test Cell Observations (All speed signals (A, B, and C) malfunction):

(1) Possible erroneous N2 indication

**Table 3. System Fault Code 4092:
N2A, N2B, and N2C Speed Signals Out of Range**

Step	Procedure	Result	Corrective Action
1.	Check generator power connections. See figure 1.		
	a. Check P118 connector.	a.1. Connector secure.	a.1. Go to b.
		a.2. Connector loose or red line visible.	a.2. Perform b. before reconnecting P118.
	b. Disconnect P118 and check for contamination, arcing, or damage in both P118 and J118.	b.1. No damage found.	b.1. Go to step 2.
		b.2. Damage found.	b.2. Repair damage as required.
2.	Check N2A and N2B signals. Disconnect P82 from DEEC. Perform the following resistance checks. See figure 1.		
	a. CONN P82 PINS 1. c to T 2. d to U 3. T to U 4. T to V 5. U to V 6. T to GND 7. T to p	a.1. Resistance checks within limits: 1. LT 5 OHMS 2. LT 5 OHMS 3. LT 10 OHMS 4. LT 10 OHMS 5. LT 10 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS	a.1. Go to step 3.
		a.2. Resistance checks out of limits.	a.2. Disconnect P118 from stator generator and go to b.
	b. CONN J118 PINS 1. G to H 2. G to J 3. H to J 4. G to GND	b.1. Resistance checks within limits: 1. LT 10 OHMS 2. LT 10 OHMS 3. LT 10 OHMS 4. GT 100,000 OHMS	b.1. Replace power and speed cable.
		b.2. Resistance checks out of limits.	b.2. Replace generator.
3.	Determine DEEC ID using EDU data review.	a. DEEC ID is 1-020402	a. Go to step 5.
		b. DEEC ID is 1-020501 and subsequent.	b. Go to step 6.
4.	deleted		

Table 3. System Fault Code 4092:
N2A, N2B, and N2C Speed Signals Out of Range (continued)

Step	Procedure	Result	Corrective Action
5.	Check N2C signal. Disconnect P50 from EDU. Perform the following resistance checks. See figure 1.		
	a. CONN P50 PINS 1. 5 to 6 2. 5 to GND	a.1. Resistance checks within limits: 1. 750 to 1200 OHMS 2. GT 100,000 OHMS	a.1. Go to step 6.
		a.2. Resistance checks out of limits.	a.2. Disconnect P118 from generator. Go to c.
	b. CONN J118 PINS 1. E to F 2. E to GND	b.1. Resistance checks within limits: 1. 750 to 1200 OHMS 2. GT 100,000 OHMS	b.1. Replace power and speed cable.
		b.2. Resistance checks out of limits.	b.2. Replace generator.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
6.	Check that EDU data has been reviewed and stored; then clear EDU data.		
7.	Perform IDLE functional check with EAU in auto search mode. Check for System Fault Code 4092. Replace components in the following order until engine operates properly:	a. System Fault Code 4092 does not repeat.	a. Return engine to service.
	• Generator Stator • DEEC • EDU • Power and Speed Cable	b. System Fault Code 4092 repeats.	b. Replace next component and repeat steps 6 and 7.

5. SYSTEM FAULT CODE 4093: N2C SPEED SIGNAL OUT OF RANGE.
(See Figure 2 and Table 4.)

a. Cause of Fault:

NOTE

This N2 speed signal is also used for test cell and external diagnostic equipment. This signal is not used by the DEEC.

(1) N2C speed signal to EDU out of 1300 to 17,000 rpm range

b. Engine Symptoms:

(1) None

c. Test Cell Observations:

(1) Erroneous N2 readout possible

(2) System fault light on

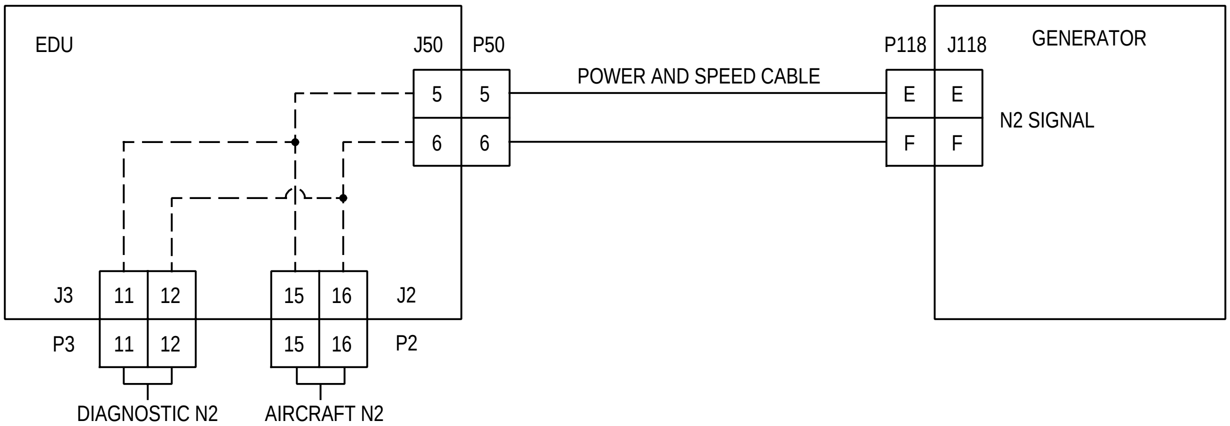
Table 4. System Fault Code 4093: N2C Speed Signal Out Of Range

Step	Procedure	Result	Corrective Action
1.	Check N2C signal. Perform the following resistance checks. See figure 2.		
	a. CONN P50 PINS	a.1. Resistance checks within limits:	a.1. Go to step 2.
	1. 5 to 6	1. 750 to 1200 OHMS	
	2. 5 to GND	2. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Disconnect P118 from generator. Go to b.
	b. CONN J118 PINS	b.1. Resistance checks within limits:	b.1. Replace power and speed cable.
	1. E to F	1. 750 to 1200 OHMS	
	2. E to GND	2. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Replace generator.

NOTE

Data not cleared from the EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform idle functional check with EAU in auto search mode. Check for System Fault Code 4093. Replace components in the following order until engine operates properly:	a. System Fault Code 4093 does not repeat.	a. Return engine to service.
	• Generator stator • EDU • Power and speed cable	b. System Fault Code 4093 repeats.	b. Replace next component and repeat steps 2 and 3.



GENERATOR N2C SIGNAL RESISTANCE LIMITS		
PINS (P50)	PINS (J118)	OHMS
5-6	E-F	750 TO 1200
5-GND	E-GND	GT 100,000

JP19 (24X2)

Figure 2. EDU N2 Signal Circuit (N2C)

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4100 - 4102: Tt2 SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 10

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 9	0				
10 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4100: Tt2A Signal Out Of Range	
	Ohmmeter	PSM-6 or equivalent
3	System Fault Code 4101: Tt2B Signal Out Of Range	
	Ohmmeter	PSM-6 or equivalent
4	System Fault Code 4102: Tt2A And Tt2B Signals Differ	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for Tt2 system.

2. SYSTEM FAULT CODE 4100: Tt2A SIGNAL OUT OF RANGE.
(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) Tt2A out of −110° to 441°F (−79° to 227°C) range.

b. Engine Symptoms:

(1) None

(2) Transfer to Secondary Mode if System Fault Code 4101 also present

c. Test Cell Observation:

(1) SYSTEM FAULT light on

d. Additional Test Cell Observations (System Fault Codes 4100 and 4101 present):

(1) SECONDARY CAUTION light on

(2) EDU Event Code 1200: Auto transfer to Secondary Mode

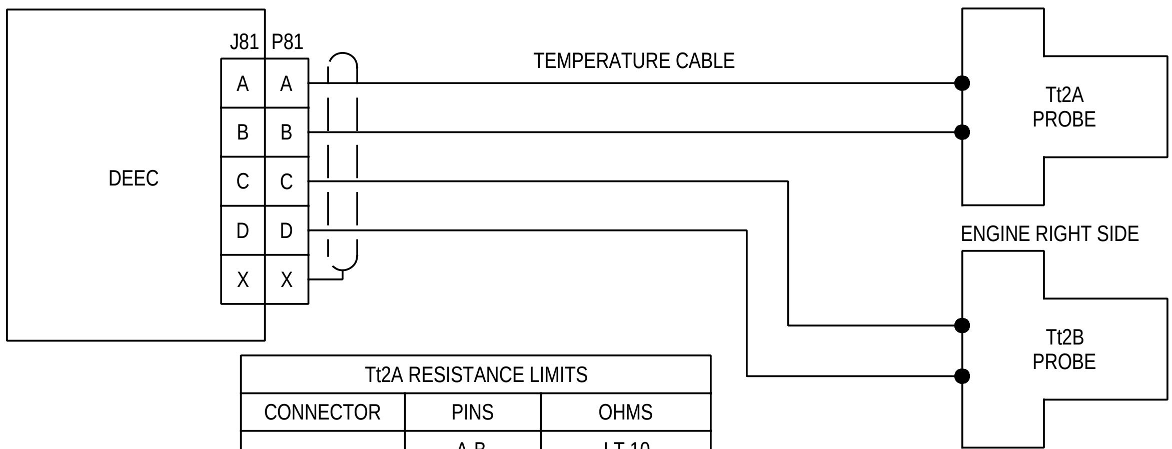
Table 1. System Fault Code 4100: Tt2A Signal Out Of Range

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks (See figure 1):		
	a. CONN P81 PINS 1. A to X	a.1. Resistance checks within limits: 1. GT 50,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace DEEC temperature cable.
	b. CONN P81 PINS 1. A to B 2. A to GND	b.1. Resistance checks within limits: 1. LT 10 OHMS 2. GT 50,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Replace DEEC temperature cable.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform IDLE functional check. Check for System Fault Code 4100 and proper engine operation.	a. System Fault Code 4100 does not repeat and engine operates properly.	a. Return engine to service.
		b. System Fault Code 4100 repeats.	b. Replace DEEC temperature cable and repeat steps 2 and 3.



Tt2A RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P81	A-B	LT 10
	A-GND	GT 50,000
	A-X	GT 50,000
Tt2B RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P81	C-D	LT 10
	C-GND	GT 50,000
	C-X	GT 50,000

JN96X1 (37X2)

Figure 1. Tt2 Temperature Probe Circuit

3. SYSTEM FAULT CODE 4101: Tt2B SIGNAL OUT OF RANGE

(See figure 1 and Table 2.)

a. Cause of Fault:

(1) Tt2B out of –110° to 441°F (–79° to 227°C) range.

b. Engine Symptoms:

(1) None

(2) Transfer to Secondary Mode if System Fault Code 4100 also present

c. Test Cell Observations:

(1) SYSTEM FAULT light on

d. Additional Test Cell Observations (System Fault Codes 4101 and 4100 present):

(1) SECONDARY CAUTION light on

(2) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 2. System Fault Code 4101:
Tt2B Signal Out Of Range

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks (See figure 1):		
	a. CONN P81 PINS 1. C to X	a.1. Resistance checks within limits: 1. GT 50,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace DEEC temperature cable.
	b. CONN P81 PINS 1. C to D 2. C to GND	b.1. Resistance checks within limits: 1. LT 10 OHMS 2. GT 50,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Replace DEEC temperature cable.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform IDLE functional check. Check for System Fault Code 4101 and proper engine operation.	a. System Fault Code 4101 does not repeat and engine operates properly.	a. Return engine to service.
		b. System Fault Code 4101 repeats.	b. Replace DEEC temperature cable and repeat steps 2 and 3.

4. SYSTEM FAULT CODE 4102: Tt2A AND Tt2B SIGNALS DIFFER.
(See figure 1 and Table 3.)

a. Cause of Fault:

(1) Tt2A and Tt2B differ by more than 20°F (11°C).

b. Engine Symptoms:

(1) None

c. Test Cell Observations:

(1) SYSTEM FAULT light on

(2) SECONDARY CAUTION light on

(3) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 3. System Fault Code 4102: Tt2A and Tt2B Signals Differ

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks (See figure 1):		
	a. CONN P81 PINS 1. A to X 2. C to X	a.1. Resistance checks within limits: 1. GT 50,000 OHMS 1. GT 50,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace DEEC temperature cable.
	b. CONN P81 PINS (Tt2A) 1. A to B 2. A to GND (Tt2B) 3. C to D 4. C to GND	b.1 Resistance checks within limits: 1. LT 10 OHMS 2. GT 50,000 OHMS 3. LT 10 OHMS 4. GT 50,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Replace DEEC temperature cable.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform IDLE functional check. Check for System Fault Code 4102 and proper engine operation.	a. System Fault Code 4102 does not repeat and engine operates properly.	a. Return engine to service.
		b. System Fault Code 4102 repeats.	b. Replace DEEC temperature cable and repeat steps 2 and 3.

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4110 - 4112: MFC PLA SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	0				
6 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for MFC PLA system.

2. SYSTEM FAULT CODE 4110: MFC PLA RESOLVER SIGNALS DIFFER.

(See Table 1.)

a. Cause of Fault:

(1) Both PLA resolver signals within 94 to 176 resolver-equivalent degree (RED) range, but more than two RED apart

b. Engine Symptom:

(1) None

c. Test Cell Observation (Either PLA signal malfunctions):

(1) SYSTEM FAULT light on

d. Additional Test Cell Observations (Both PLA signals malfunction):

(1) SECONDARY CAUTION light on

(2) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 1. System Fault Code 4110: MFC PLA Resolver Signals Differ

Step	Procedure	Result	Corrective Action
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
1.	Check that EDU data has been reviewed and stored; then clear EDU data.		
2.	Perform IDLE functional check. Check for System Fault Code 4110. Replace components in following order until engine operates properly:	a. System Fault Code 4110 does not repeat.	a. Return engine to service.
	• MFC PLA resolver module • DEEC • MFC • MFC cable	b. System Fault Code 4110 repeats.	b. Replace next component and repeat steps 1 and 2.

3. SYSTEM FAULT CODE 4111: MFC PLA1 RESOLVER SIGNAL OUT OF RANGE. (See Table 2.)

a. Cause of Fault:

(1) PLA1 resolver signal out of 94 to 176 resolver-equivalent-degree (RED) range.

b. Engine Symptoms:

(1) None

(2) Transfer to Secondary Mode if System Fault Code 4112 also present

c. Test Cell Observation:

(1) SYSTEM FAULT light on

d. Additional Test Cell Observations (System Fault Codes 4111 and 4112 present):

(1) SECONDARY CAUTION light on

(2) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 2. System Fault Code 4111: MFC PLA1 Resolver Signal Out Of Range

Step	Procedure	Result	Corrective Action
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
1.	Check that EDU data has been reviewed and stored; then clear EDU data.		
2.	Perform IDLE functional check. Check for System Fault Code 4111. Replace components in following order until engine operates properly:	a. System Fault Code 4111 does not repeat.	a. Return engine to service.
	• MFC PLA resolver module • DEEC • MFC • MFC cable	b. System Fault Code 4111 repeats.	b. Replace next component and repeat steps 1 and 2.

4. SYSTEM FAULT CODE 4112: MFC PLA2 RESOLVER SIGNAL OUT OF RANGE. (See Table 3.)

a. Cause of Fault:

(1) PLA2 resolver signal out of 94 to 176 resolver-equivalent-degree (RED) range.

b. Engine Symptoms:

(1) None

(2) Transfer to Secondary Mode if System Fault Code 4111 also present

c. Test Cell Observation:

(1) SYSTEM FAULT light on

d. Additional Test Cell Observations (System Fault Codes 4112 and 4111 present):

(1) SECONDARY CAUTION light on

(2) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 3. System Fault Code 4112: MFC PLA2 Resolver Signal Out Of Range

Step	Procedure	Result	Corrective Action
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
1.	Check that EDU data has been reviewed and stored; then clear EDU data.		
2.	Perform IDLE functional check. Check for System Fault Code 4112. Replace components in following order until engine operates properly:	a. System Fault Code 4112 does not repeat.	a. Return engine to service.
	• MFC PLA resolver module • DEEC • MFC • MFC cable	b. System Fault Code 4112 repeats.	b. Replace next component and repeat steps 1 and 2.

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4120 and 4121: Ps2 SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 16

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	11	4	11	6A Added	9
2	9	4A Added	9	6B Blank Added	9
2A - 2B Added	9	4B Blank Added	9	7 - 10	0
3	9	5 - 6	9		

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Idle Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
DEEC Pressure Sensing System Analysis	WP 675 00
Compressive Engine Diagnostic System	T.O. 33D4-6-746-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T.O. No.	Date	Level	Title (ECP No.)
T.O. 2J-F100229-517	15 Oct 92	O/I	Anti-Ice Valve Thermal Loop Isolation with New Manifold Assembly, Revised Electrical Harnesses, New Tubes and Brackets, F100-PW-229 Engines, F-15/F-16 Aircraft (ECP 92QA106 and ECP 90QA293C1))
T.O. 2J-F100229-518	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-15 Aircraft (ECP 92QA093)
T.O. 2J-F100229-519	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-16 Aircraft (ECP 92QA093)
T.O. 2J-F100229-524	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-15 Aircraft (ECP 92QA141)
T.O. 2J-F100229-525	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-16 Aircraft (ECP 92QA141)

CONSUMABLE MATERIALS

None

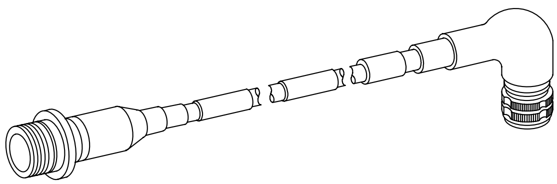
EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

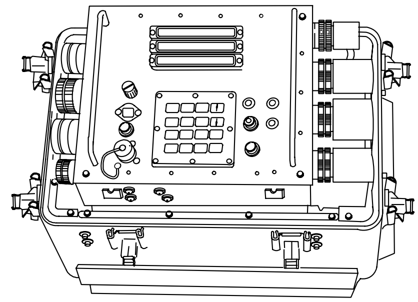
Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4120: Ps2 Probe Heater Malfunction	
	Volt/Ohmmeter	PSM-6 or Equivalent
	Interface cables	PWA 56032 or PWA 56033
	Engine Anlyzer Unit	PWA 56084
	CEDS Software	PWA 56091
	Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114

ILLUSTRATED SUPPORT EQUIPMENT



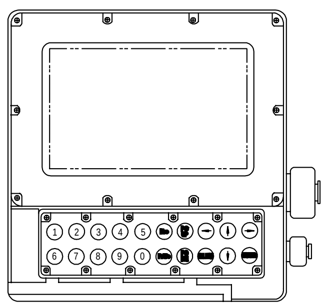
PWA 56033 –C

Figure T1. PWA 56032/PWA 56033 Interface Cable (Typical)



PWA 56016 –C

Figure T2. PWA 56084 Engine Analyzer Unit



PWA 56102 –C

Figure T3. PWA 56102 Transfer Unit

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for Ps2 probe.

2. SYSTEM FAULT CODE 4120: Ps2 PROBE HEATER MALFUNCTION.

(See Figure 1 and Table 1.)

a. Description.

(1) Ps2 heater prevents ice formation on Ps2 probe which affects Ps2 signal to DEEC. Heater is constantly powered by generator.

(2) Temperature sensor at Ps2 probe heater signals DEEC that Ps2 heater is not functioning.

b. Cause of Fault.

NOTE

Moisture can enter ceramic potting compound in Ps2 probe terminal can and connector resulting in 4120 Fault Codes.

(1) Malfunctioning Ps2 probe temperature sensor circuits.

(2) Ps2 probe temperature sensor detects an anti-ice overtemp (out-of-range temperature).

c. Engine Symptoms.

(1) None

d. Test Stand Observation.

(1) SYSTEM FAULT light ON.

Table 1. System Fault Code 4120: Ps2 Probe Heater Malfunction

Step	Procedure	Result	Corrective Action
	WARNING The location and length of an installed Ps2 probe can cause injury. Care must be taken while working in or approaching Ps2 probe area.		
1.	a. Determine if System Fault Code 4251 or Event Code 1180 are present.	a.1. System Fault Code 4251 or Event Code 1180 is present.	a.1. Troubleshooting is not required.
		a.2. System Fault Code 4251 or Event Code 1180 is not present.	a.2. Go to step b.
	NOTE Ps2 probes containing electrical cable PN ESD 46199 (marked on probe electrical connector) can be sealed against moisture. Refer to T.O. 2J-F100-53-4, WP 015 00.		
	b. Determine if moisture is cause for repeating System Fault Code 4120.	b.1. Moisture is suspect.	b.1. Go to step 1.c.
		b.2. Moisture is not suspect.	b.2. Go to step 2.
	c. Perform IDLE Functional Check per WP 216 00. With CEDS, or EAU inAuto-Search Mode and anti-icing air ON for 10 minutes, per WP 216 00. Cycle IAR and determine if System Fault Code 4120 repeated.	c.1. System Fault Code 4120 repeated.	c.1. Go to step 2.
		c.2. System Fault Code 4120 did not repeat.	c.2. Return engine to service.

Table 1. System Fault Code 4120: Ps2 Probe Heater Malfunction (continued)

Step	Procedure	Result	Corrective Action
2.	Perform the following resistance checks. See figure 1.		
	a. CONN P82 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	1. J to p	1. GT 25,000 OHMS	
	2. H to J	2. 85 to 300 OHMS	
	3. h to J	3. 85 to 300 OHMS	
	4. J to GND	4. GT 25,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Disconnect P142 connector from fan inlet case. Go to d.
	b. CONN P118 PINS	b.1. Resistance checks within limits.	b.1. Go to c.
	1. L to M	1. 20 to 100 OHMS	
	2. L to GND	2. GT 25,000 OHMS	
	3. L to D	3. GT 25,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Disconnect P142 connector from fan inlet case. Go to d.

Table 1. System Fault Code 4120: Ps2 Probe Heater Malfunction (continued)

Step	Procedure	Result	Corrective Action
2. (cont'd)	c. CON J118 PINS	c.1. Resistance checks within limits:	c.1. Go to step 3.
	1. L to M	1. LT to 5 OHMS	
	2. L to GND	2. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Replace generator stator.
	d. CON J142 PINS	d.1. Resistance checks within limits:	d.1. Replace power and speed cable.
	1. A to B	1. 20 to 100 OHMS	
	2. C to D	2. 85 to 300 OHMS	
	3. A to C	3. GT 25,000 OHMS	
	4. A to GND	4. GT 25,000 OHMS	
	5. C to GND	5. GT 25,000 OHMS	
		d.2. Resistance checks out of limits.	d.2. Remove Ps2 probe from inlet fan case. Remove connector from Ps2 probe. Go to e.
	e. CON J142 PINS	e.1. Resistance checks within limits:	e.1. Replace Ps2 probe.
	1. A to A	1. LT 5 OHMS	
	2. B to B	2. LT 5 OHMS	
	3. C to C	3. LT 5 OHMS	
	4. D to D	4. LT 5 OHMS	
	5. A to GND	5. GT 25,000 OHMS	
	6. C to GND	6. GT 25,000 OHMS	
		e.2. Resistance checks out of limits.	e.2.a. Replace Ps2 probe fan inlet case cable.

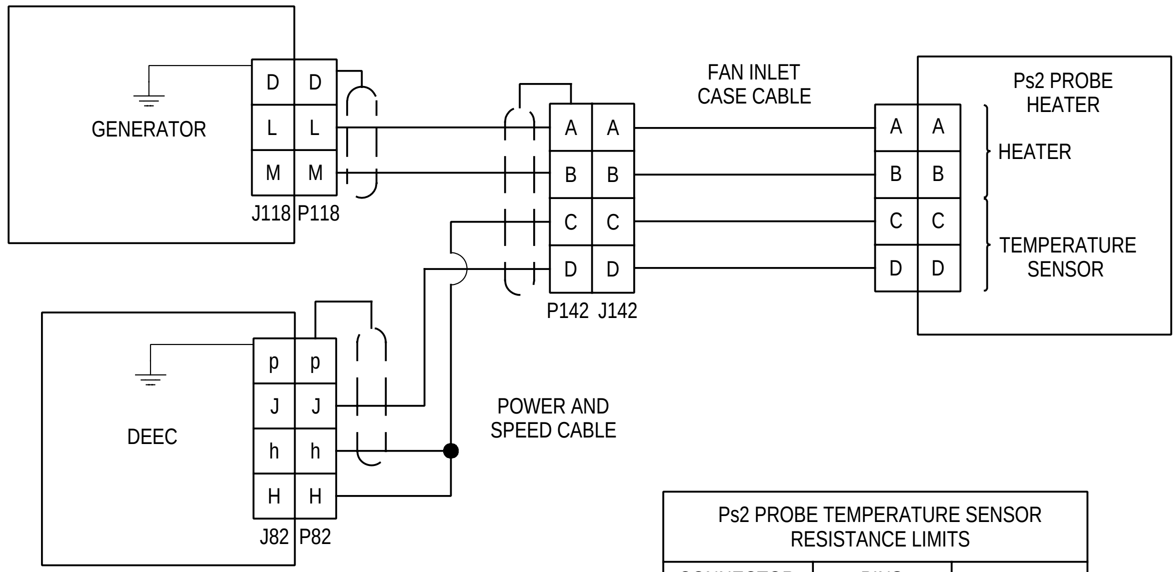
NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored; then clear EDU data.		

Table 1. System Fault Code 4120: Ps2 Probe Heater Malfunction (continued)

Step	Procedure	Result	Corrective Action
4.	Perform IDLE Functional Check per WP 216 00. With anti-ice air ON, cycle IAR. If System Fault code 4120 repeats, replace components in the following order until engine operates properly:	a. Fault Code 4120 does not repeat.	a. Return engine to service.
	• Ps2 Probe • Inlet Case Cable • Stator Generator • DEEC • Power and Speed Cables	b. Fault Code 4120 repeats.	b. Replace next component. Repeat steps 3 and 4.



Ps2 PROBE HEATER RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P118	L – M	20 TO 100
	L – GND	GT 25,000
	L – D	GT 25,000
J142	A – B	20 TO 100
	A – GND	GT 25,000
	A – C	GT 25,000
Ps2 PROBE HEATER	A – B	20 TO 100
	A – GND	GT 25,000
Ps2 HEATER GENERATOR WINDING RESISTANCE LIMITS		
J118	L – M	LT 5
	L – GND	GT 100,000

Ps2 PROBE TEMPERATURE SENSOR RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P82	H – J	85 TO 300
	h – J	85 TO 300
	J – GND	GT 25,000
	J – p	GT 25,000
J142	C – D	85 TO 300
	C – GND	GT 25,000
Ps2 PROBE TEMPERATURE SENSOR	C – D	85 TO 300
	C – GND	GT 25,000

5908 (36X2)

Figure 1. Ps2 Probe Circuit

3. SYSTEM FAULT CODE 4121: Ps2 PRESSURE SYSTEM MALFUNCTION.
(See Figure 2 and Table 2.)

a. Cause of Fault:

(1) Ps2 exceeds 0.5 to 49.9 psia range.

(2) Ps2 calculated using Ps2 is out of range, while Pb calculated using Pt6 is in range, indicating Ps2 error.

(3) DEEC Ps2 transducer contaminated with fluid.

b. Engine Symptoms:

(1) Augmentation inhibited or cancelled.

(2) Aj trim inhibited.

(3) Transfer to SEC mode if System Fault Code 4122 present.

c. Test Stand Observations:

(1) System fault light on

(2) Augmentor/Mn fault light on.

(3) Engine caution light on.

(4) Event Code 1220: Augmentor Inhibit.

d. Additional Observations (System Fault Code 4121 with 4122 present):

(1) SEC caution light on.

(2) Event Code 1200: Auto transfer to SEC mode.

Table 2. System Fault Code: 4121 Ps2 Pressure System Malfunction

Step	Procedure	Result	Corrective Action
1.	Perform DEEC pressure sensing system analysis.	a. Analysis passed.	a. Return engine to service.
		b. Analysis noted problem.	b. Replace components as required. Go to step 2.
2.	Remove Ps2 line from DEEC and inspect transducer port for fluid contamination.	a. No fluid was seen in the Ps2 transducer port.	a. Continue to step 3.
		b. Fluid was seen in the Ps2 transducer port.	b. Remove and replace DEEC.
3.	Inspect DEEC Ps2 sense line for leaks, loose fittings, chafing, and blockage. See figure 2.	a. No plumbing problems noted.	a. Continue to step 4.
		b. Plumbing problems noted.	b. Repair plumbing as required.
4.	Start engine and stabilize at IDLE for 5 minutes. Snap throttle to Intermediate (MIL) and stabilize 3 minutes. Compare test stand and EMSE Ps2 values. Retard throttle to IDLE and stabilize 5 minutes. Shut down engine when test is finished.	a. Test stand and EMSE Ps2 values within limits: 0.0 to 0.4 in. Hg.	a. Go to step 5.
		b. Ps2 values out of limits.	b.1.Check Ps2 sense line plumbing for leaks etc. See figure 2. b.2.If problem still exists, perform Ps2 vacuum and airflow check. Repair Ps2 system as required.
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
5.	Check that EDU data has been reviewed and stored; then clear EDU data.		
6.	If System Fault Code 4121 repeats, replace components in the following order, if component has not been previously changed, until engine operates properly:	a. System Fault Code 4121 does not repeat.	a. Return engine to service.
	• DEEC • Ps2 sense line plumbing • Ps2 probe • Inlet Case	b. System Fault Code 4121 repeats.	b. Replace next component. Repeat steps 5 and 6.

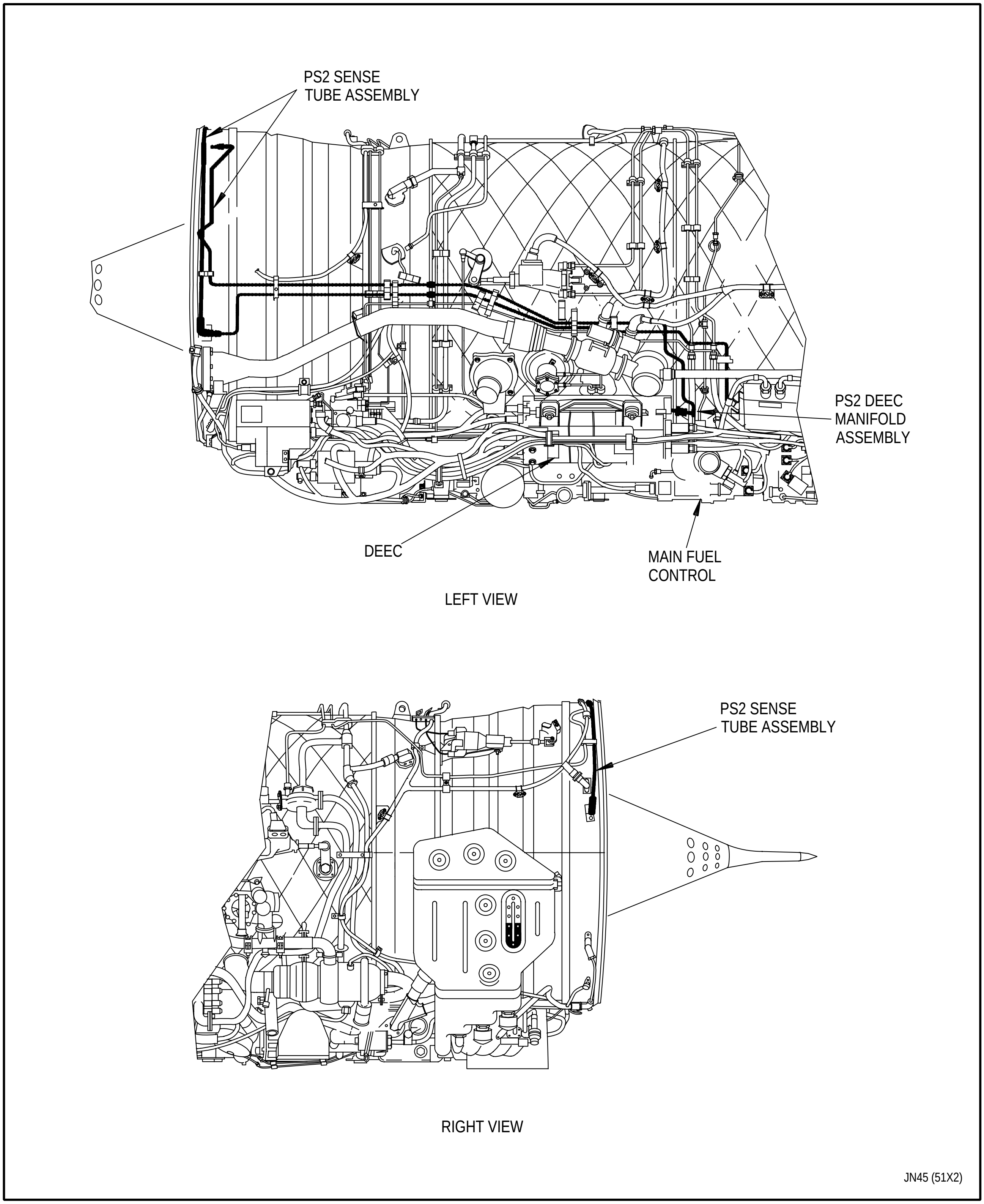


Figure 2. DEEC Ps2 Sense Line Inspection

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4122: Pb SENSOR

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 10

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Troubleshooting	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
EAU Built-In Test	WP 654 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
DEEC Pressure Sensing System Analysis	WP 675 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Control - Engine, Digital Electronic	WP 007 00
Engine	T.O. 2J-F100-53-5
Cable, Hose, Tube, and Manifold Assemblies; Engine External - Installation, Routing, and Clamping	WP 064 00
Engine Analyzer Unit - Operation Instructions (This unit is designated as a jet engine analyzer unit in referenced technical manual.)	T.O. 33D4-6-684-1
Comprehensive Engine Diagnostic System	T.O. 33D4-6-7-746-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T.O. No.	Date	Level	Title (ECP No.)
T.O. 2J-F100229-517	15 Oct 92	O/I	Anti-Ice Valve Thermal Loop Isolation with New Manifold Assembly, Revised Electrical Harnesses, New Tubes and Brackets, F100-PW-229 Engines, F-15/F-16 Aircraft (ECP 92QA106 and ECP 90QA293C1))
T.O. 2J-F100229-518	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-15 Aircraft (ECP 92QA093)

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS (continued)

T.O. No.	Date	Level	Title (ECP No.)
T.O. 2J-F100229-519	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-16 Aircraft (ECP 92QA093)
T.O. 2J-F100229-524	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-15 Aircraft (ECP 92QA141)
T.O. 2J-F100229-525	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-16 Aircraft (ECP 92QA141)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4122: Pb Sensor	
	Interface cables	PWA 56032 or PWA 56033
	Engine analyzer unit	PWA 56084
	CEDS Software	PWA 56091
	Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114

ILLUSTRATED SUPPORT EQUIPMENT

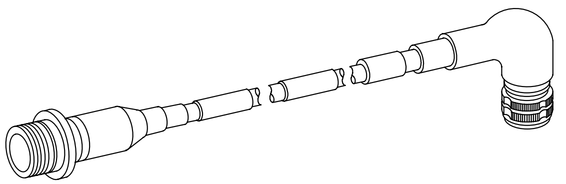

PWA 56033 –C

Figure T1. PWA 56032/PWA 56033 Interface Cable (Typical)

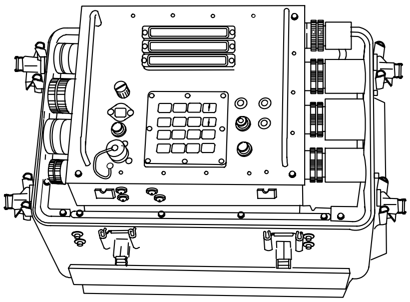
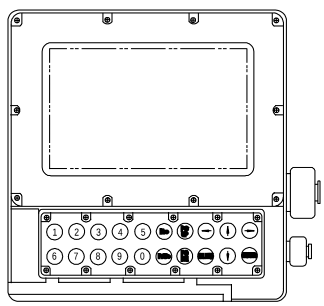

PWA 56016 –C

Figure T2. PWA 56084 Engine Analyzer Unit



PWA 56102 –C

Figure T3. PWA 56102 Transfer Unit

1. INTRODUCTION.

This work package contains troubleshooting procedure for Pb sensor.

2. SYSTEM FAULT CODE 4122: Pb PRESSURE SYSTEM MALFUNCTION. (See Figure 1 and Table 1.)

a. Cause of Fault.

(1) Pb out of 1.0 to 649.0 psia range.

(2) Pb signal decreases with Pb references.

(3) DEEC Pb transducer contaminated with fluid.

b. Engine Symptoms.

(1) Slightly longer Accels/ Decels

(2) Augmentation cancelled or inhibited

(3) Possible transfer to SEC Mode.

c. Test Stand Observations.

(1) System fault light ON

(2) Augmentor/Mn fault light ON

(3) Engine caution light ON

(4) Event Code 1220: Augmentor Inhibit

d. Additional Observation (if auto transfer to SEC Mode).

(1) SEC caution light ON

(2) Event Code 1200: Auto transfer to SEC Mode

Table 1. System Fault Code 4122: Pb Pressure System Malfunction

Step	Procedure	Result	Corrective Action
1.	Remove Pb line from DEEC and inspect transducer port for fluid contamination.	a. No fluid was seen in the Pb transducer port.	a. Continue to step 2.
		b. Fluid was seen in the Pb transducer port.	b. Remove and replace DEEC.If contaminant is fuel, inspect AFPC for leak source.
2.	Inspect DEEC Pb sense line for leaks, loose fittings, chafing, and blockage. See figure 1.	a. No plumbing problems noted.	a. Continue to step 3.
		b. Plumbing problems noted.	b. Repair plumbing as required.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored; then clear EDU data.		
4.	Connect CEDS or EAU to EDU for engine monitoring (real-time read). Start engine and stabilize at IDLE for 5 minutes. Using CEDS or EAU in auto-search mode, snap throttle to Intermediate (MIL) and stabilize 3 minutes. Compare test stand and CEDS (EDU Pb) or EAU (word 1093) Pb values. Retard throttle to IDLE and stabilize 5 minutes. Shut down engine when test is finished.	a. Test stand and CEDS or EAU Pb values within limits, ±5.0 psia.	a. Go to step 5.
		b. Pb values out of limits.	b. Remove and replace DEEC.

Table 1. System Fault Code 4122: Pb Pressure System Malfunction (continued)

Step	Procedure	Result	Corrective Action
5.	If System Fault Code 4122 repeats, replace components in the following order, if component has not been previously changed, until engine operates properly. Refer to T.O. 2J-F100-53-4, WP 007 00 or 2J-F100-53-5, WP 064 00.	a. System Fault Code 4122 does not repeat.	a. Return engine to service.
	• DEEC • Pb sense line plumbing Pb diffuser case • jumper tube	b. System Fault Code 4122 repeats.	b. Repeat next component. Repeat steps 3 through 5.

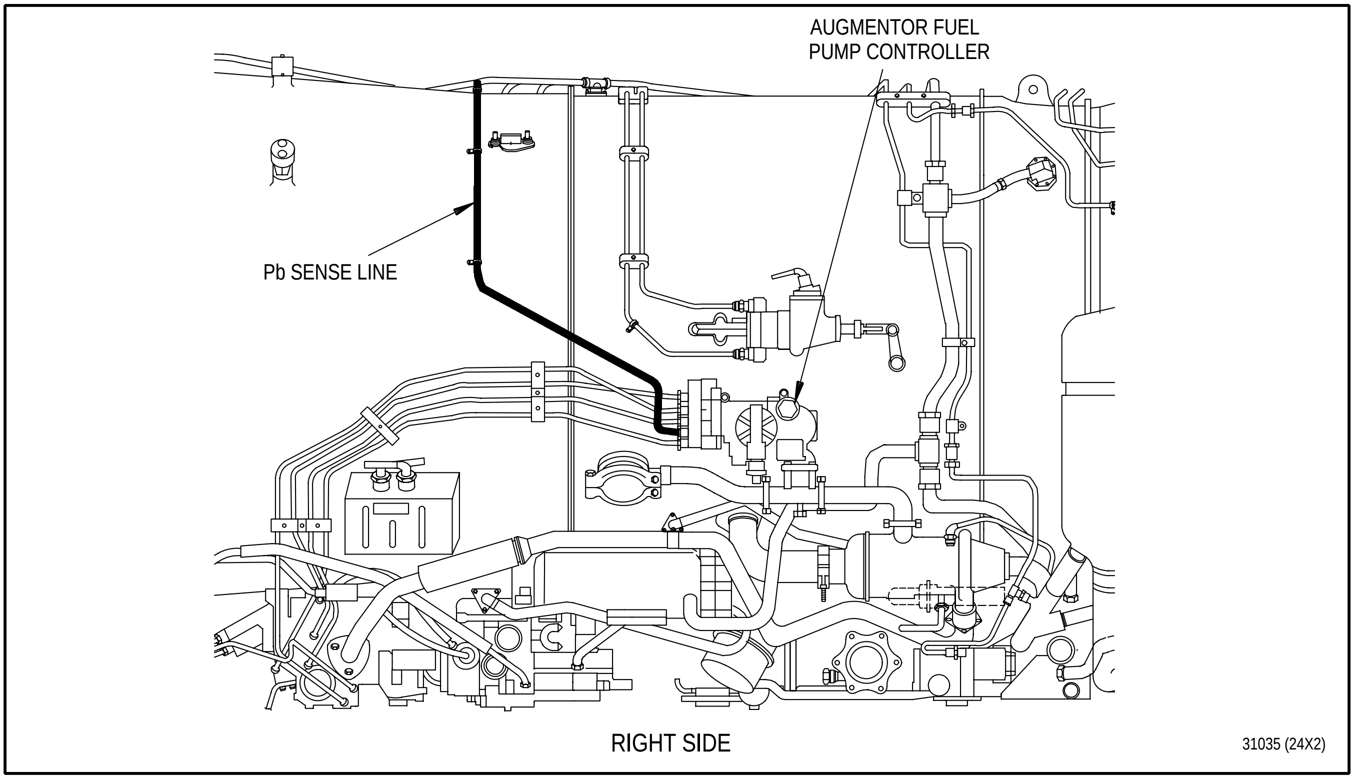


Figure 1. Pb Sense Line - Inspection (Sheet 1 of 3)

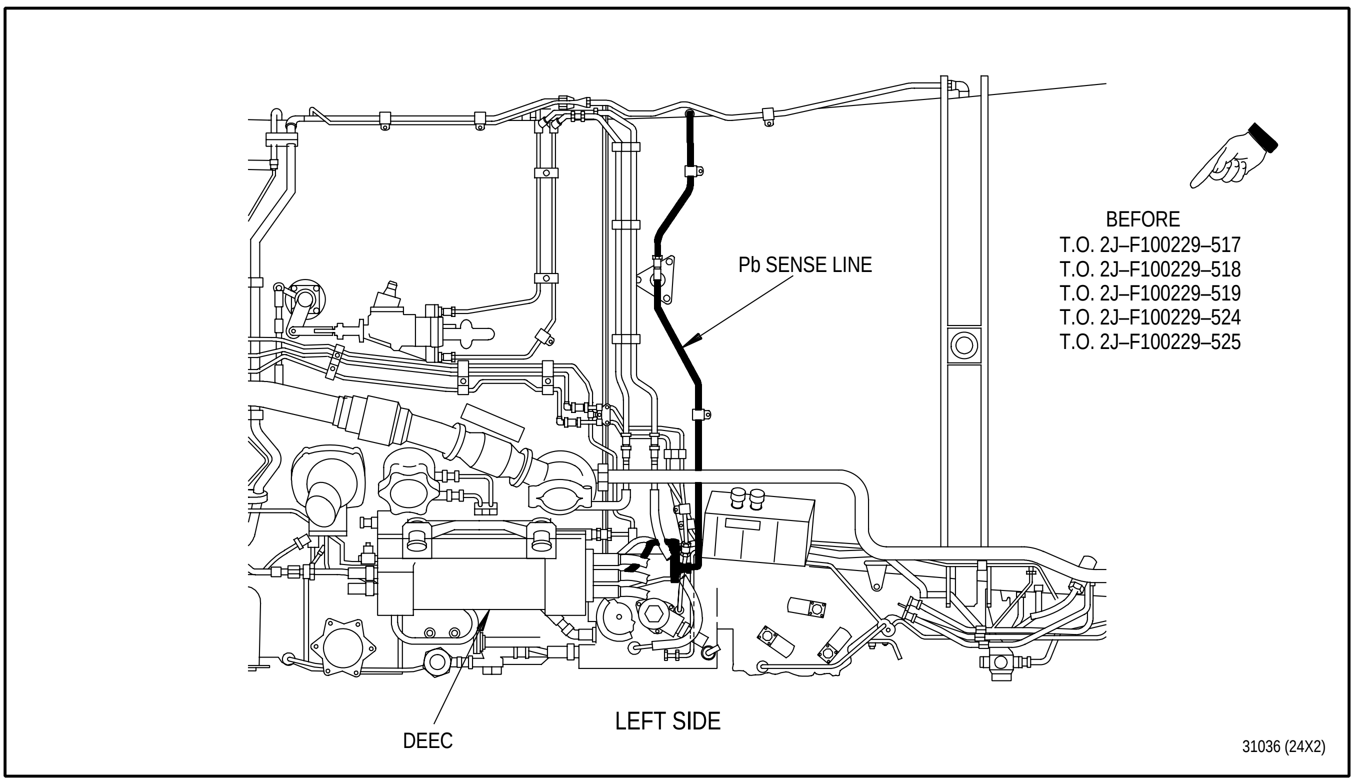


Figure 1. Pb Sense Line - Inspection (Sheet 2 of 3)

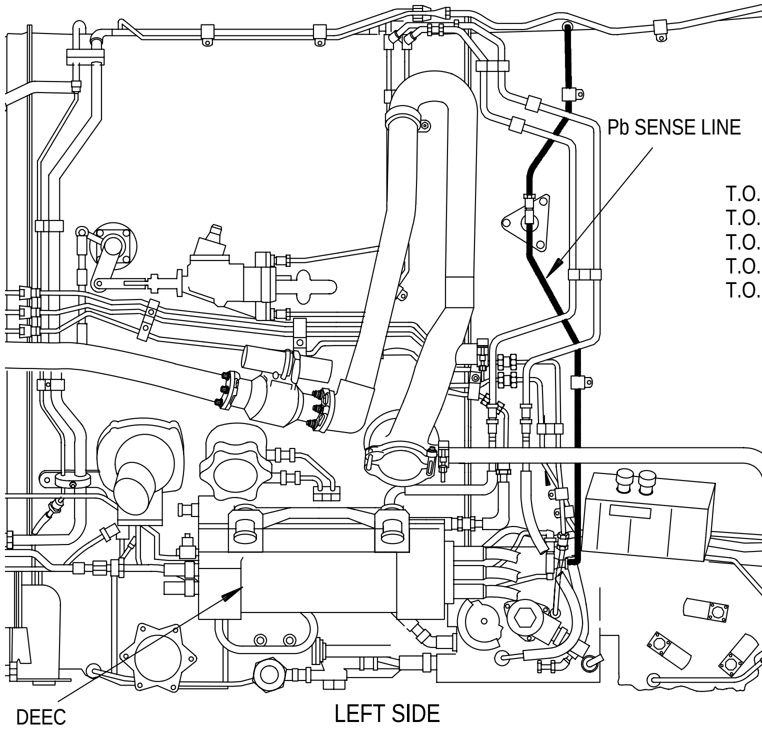


Figure 1. Pb Sense Line - Inspection (Sheet 3 of 3)

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4123:
Pt6 SENSOR

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
DEEC Pressure Sensing System Analysis	WP 675 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for Pt6 sensor.

2. SYSTEM FAULT CODE 4123: Pt6 PRESSURE SYSTEM MALFUNCTION.

(See Figure 1 and Table 1.)

a. Cause of Fault.

(1) Pt6m out of 1.0 to 109.8 psia range.

(2) Pt6 as measured by the DEEC differs from calculated Pb and Pt6 references.

(3) DEEC Pt6 transducer contaminated with fluid.

b. Engine Symptoms.

(1) Aj trim inhibited

(2) Augmentation inhibited

(3) Transfer to SEC mode if System Fault Code 4122 also present

c. Test Stand Observations.

(1) System fault light on

(2) Augmentation inhibited

(3) Augmentor/Mn fault light on

(4) Event Code 1220: Augmentor Inhibit

(5) Engine caution light on.

Table 1. System Fault Code 4123: Pt6 Pressure System Malfunction

Step	Procedure	Result	Corrective Action
1.	Perform DEEC pressure sensing system analysis.	a. Analysis passed.	a. Return engine to service.
		b. Analysis noted problem.	b. Replace components as required. Go to step 2.
2.	Remove Pt6 line from DEEC and inspect transducer port for fluid contamination.	a. No fluid was seen in the Pt6 transducer port.	a. Continue to step 3.
		b. Fluid was seen in the Pt6 transducer port.	b. Remove and replace DEEC.
3.	Inspect DEEC Pt6 sense line for leaks, loose fittings, chafing, and blockage. See figure 1.	a. No plumbing problems noted.	a. Continue to step 4.
		b. Plumbing problems noted.	b. Repair plumbing as required.
4.	Start engine and stabilize at IDLE for 5 minutes. Snap throttle to Intermediate (MIL) and stabilize 3 minutes. Compare test stand and EMSE Pt6 values. Retard throttle to IDLE and stabilize 5 minutes. Shut down engine when test is finished.	a. Test stand and EMSE Pt6 values within limits, ±1.0 in. Hg.	a. Go to step 5.
		b. Pt6 values out of limits.	b.1. Check Pt6 sense line plumbing for leaks etc. See figure 1.
			b.2. If problem still exists, perform Pt6 vacuum check. Repair Pt6 system as required.

Table 1. System Fault Code 4123: Pt6 Pressure System Malfunction (continued)

Step	Procedure	Result	Corrective Action
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
5.	Check that EDU data has been reviewed and stored; then clear EDU data.		
6.	If System Fault Code 4123 repeats, replace components in the following order, if component has not been previously changed, until engine operates properly:	a. System Fault Code 4123 does not repeat.	a. Return engine to service.
	• DEEC • Pt6 sense line plumbing • Pt6 probe	b. System Fault Code 4123 repeats.	b. Replace next component. Repeat steps 5 and 6.

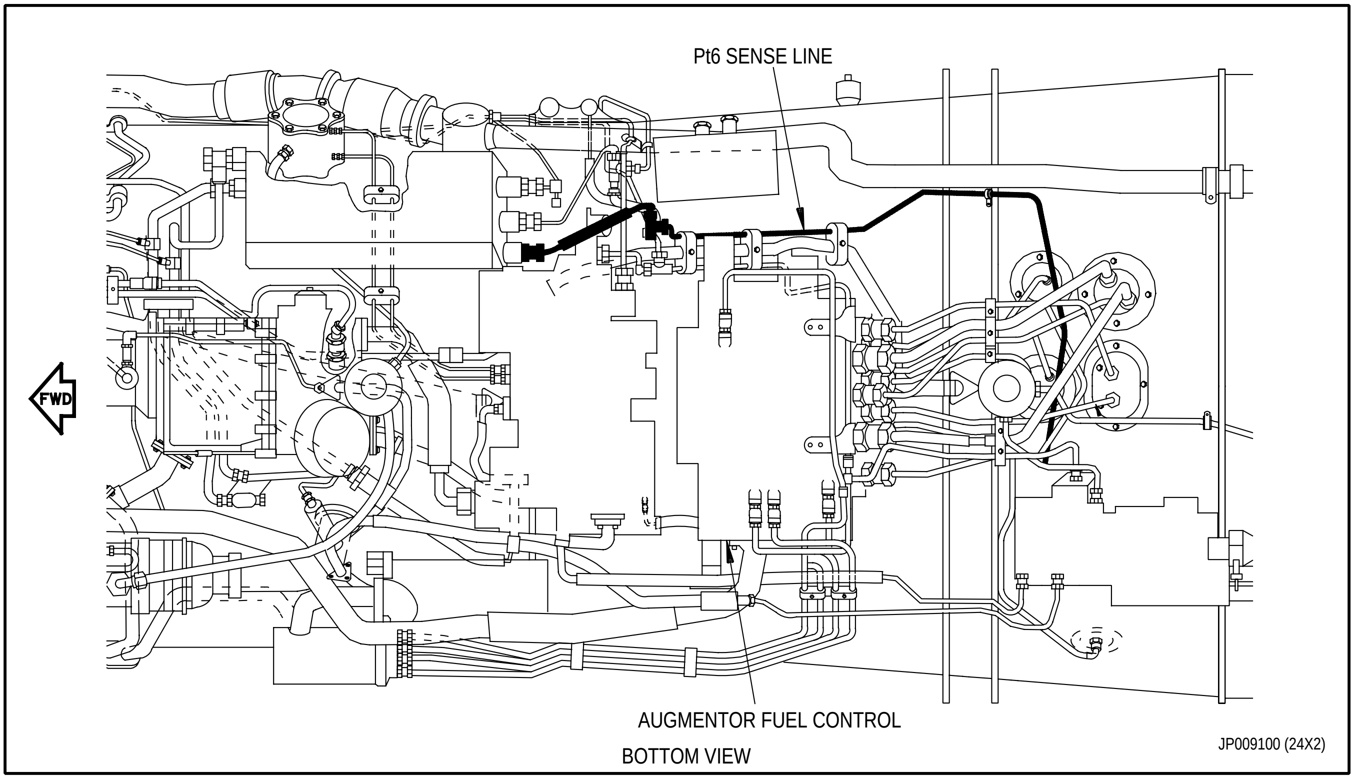


Figure 1. Pt6 Sense Line - Inspection

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4130: SECONDARY MODE Ps2

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Test Requirements	WP 206 00
Engine Acceptance Test	WP 212 00
Secondary Mode Functional Check	WP 215 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4130: MFC SEC Ps2 Sensor	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for Secondary Mode (SEC) Ps2.

2. SYSTEM FAULT CODE 4130: MFC SEC Ps2 SENSOR.

(See Figure 1 and Table 1.)

a. Cause of Fault:

NOTE

- If fault occurs after first start following engine fuel system maintenance, preserving, or initial assembly, no maintenance is required.
- Ps2 diagnostic switch is normally spring loaded closed at engine shutdown.

(1) Main fuel control (MFC) detected less than 0.9 psia Ps2 at IDLE in Secondary Mode. MFC closed Ps2 diagnostic switch circuit to EDU and set a fail-safe Ps2 of 12 psia.

b. Engine Symptoms:

(1) Primary Mode: No effect

(2) Secondary Mode: Excess fuel flow at altitudes where Ps2 is less than 12 psia

c. Test Cell Observations:

(1) Primary Mode: No effect

(2) Secondary Mode: High Intermediate (MIL) parameters at simulated altitudes where Ps2 is less than 12 psia

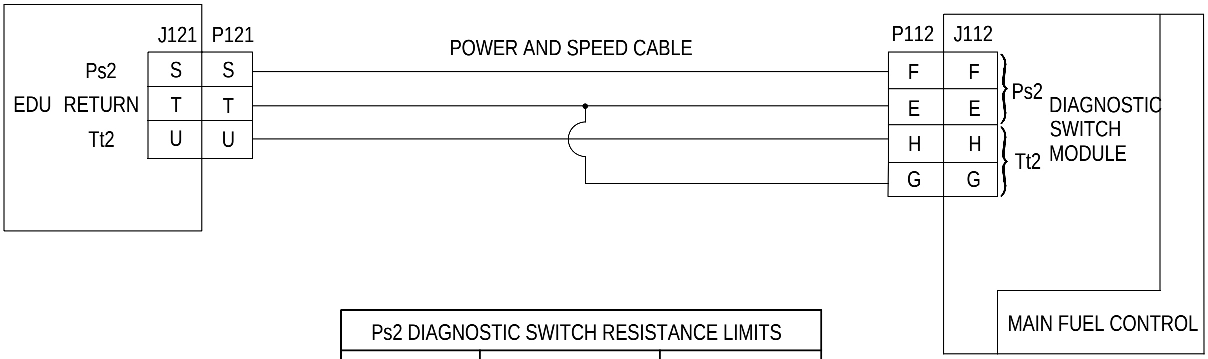
(3) SYSTEM FAULT light on

**Table 1. System Fault Code 4130:
MFC SEC Ps2 Sensor**

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks on Ps2 diagnostic circuit (See figure 1):	a.1. Resistance checks are within limits:	a.1. Go to step 2.
	a. CONN P121 PINS		
	1. S to T 2. S to GND	1. LT 5 OHMS GT 2. 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Go to b.
	b. CONN J112 PINS	b.1. Resistance checks within limits.	b.1. Replace power and speed cable.
	1. F to E 2. F to GND	1. LT 5 OHMS GT 2. 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Replace diagnostic switch module.
2.	Disconnect P121 and P112. Perform the following resistance checks on power and speed cable.		
	CONN P121 PIN	a. Resistance check within limits.	a. Go to step 3.
	1. S to T 2. S to GND	1. GT 100,000 OHMS 2. GT 100,000 OHMS	
		b. Resistance checks out of limits.	b. Replace power and speed cable.

Table 1. System Fault Code 4130:MFC SEC Ps2 Sensor (continued)

Step	Procedure	Result	Corrective Action
NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.			
3.	Check that EDU data has been reviewed and stored; then clear EDU data.		
4.	Perform IDLE functional check. Check for System Fault Code 4130. Replace components in following order until engine operates properly:	a. System Fault Code 4130 does not repeat.	a. Return engine to service.
	• Diagnostic switch module • MFC • EDU • Power and speed cable	b. System Fault Code 4130 repeats.	b. Replace next component. Repeat steps 3 and 4.



Ps2 DIAGNOSTIC SWITCH RESISTANCE LIMITS		
PINS (P121)	PINS (J112)	OHMS
S-T	F-E	LT 5
S-GND	F-GND	GT 100,000

JN83 (18X2)

Figure 1. MFC Ps2 Diagnostic Switch Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4140: SECONDARY MODE Tt2

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4140: MFC SEC Tt2 Sensor	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for Secondary Mode (SEC) Tt2.

2. SYSTEM FAULT CODE 4140: MFC SEC Tt2 SENSOR.

(See Figure 1 and Table 1.)

a. Cause of Fault:

NOTE

- If fault occurs after the first start following engine fuel system maintenance, preservation, or initial assembly, no maintenance is required.
- Tt2 diagnostic switch is normally spring loaded closed at engine shutdown.

(1) Main fuel control (MFC) detects less than –142°F (–97°C) Tt2 in Secondary Mode. MFC closed Tt2 diagnostic switch circuit to EDU and set a fail-safe Tt2 of 68°F (20°C).

b. Engine Symptoms:

(1) Primary Mode: No effect

(2) Secondary Mode: Reduced thrust at altitude where Tt2 is less than 68°F (20°C); Increased thrust at altitude where Tt2 is more than 68°F (20°C)

c. Test Cell Observations:

(1) Primary Mode: No effect.

(2) Secondary Mode: Lower Intermediate (MIL) power parameters at simulated altitudes where Tt2 is less than 68°F (20°C)

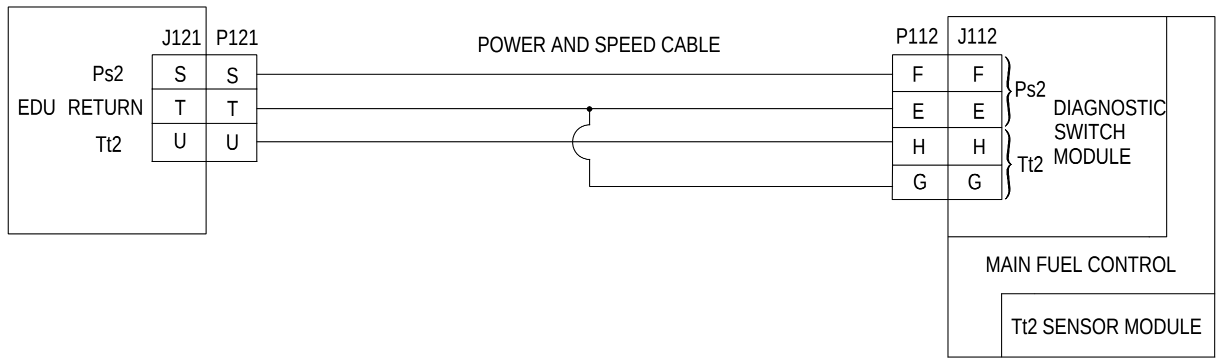
(3) SYSTEM FAULT light on

Table 1. System Fault Code 4140: MFC SEC Tt2 Sensor

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks on Tt2 diagnostic circuit (See figure 1):		
	a. CONN P121 PINS	a.1. Resistance checks within limits:	a.1. Go to step 2.
	1. T to U 2. T to GND	1. LT 5 OHMS 2. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Go to b.
	b. CONN J112 PINS	b.1. Resistance checks within limits.	b.1. Replace power and speed cable.
	1. G to H 2. H to GND	1. LT 5 OHMS 2. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Tt2 sensor module.
2.	Disconnect P121 and P112. Perform the following resistance checks on power and speed cable:		
	a. CONN P112 PINS	a. Resistance checks within limits.	a. Go to step 3.
	1. G to H 2. H to GND	1. GT 100,000 OHMS 2. GT 100,000 OHMS	
		b. Resistance checks out of limits.	b. Replace power and speed cable.
3.	Perform visual inspection of MFC SEC Tt2 and related plumbing.	a. No defects or damage.	a. Go to step 4.
		b. Defects or damage.	b. Replace or repair parts as necessary.

Table 1. System Fault Code 4140: MFC SEC Tt2 Sensor (continued)

Step	Procedure	Result	Corrective Action
NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.			
4.	Check that EDU data has been reviewed and stored; then clear EDU data.		
5.	Perform IDLE functional check. Check for System Fault Code 4140. Replace components in following order until engine operates properly:	a. System Fault Code 4140 does not repeat.	a. Return engine to service.
	• Tt2 sensor module • MFC • EDU • Power and speed cable	b. System Fault Code 4140 repeats.	b. Replace next component and repeat steps 4 and 5.



Tt2 DIAGNOSTIC SWITCH RESISTANCE LIMITS		
PINS (P112)	PINS (J112)	OHMS
T-U	G-H	LT 5
T-GND	G-GND	GT 100,000

JN84 (24X2)

Figure 1. MFC Tt2 Diagnostic Switch Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4160: LOD UNIT

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 10

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	28	3 - 4	2	8 - 9 Added	28
2	0	5 - 7	28	10 Blank Added	28

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-51-2
Idle Functional Check	WP 016 00
Engine Troubleshooting	T.O. 2J-F100-51-3
Engine Troubleshooting - General	WP 003 00
Downloading and Reviewing Data Using CEDS	WP 180 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 181 00
Clearing Engine Faults/Events and Data Using CEDS	WP 183 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4160: LOD Self-Test Failure	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for light-off detector (LOD).

2. SYSTEM FAULT CODE 4160: LOD SELF-TEST FAILURE.
(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) DEEC does not receive LOD flame-on feedback signal within a specific time interval. During LOD self-test, with PLA less than 25 degrees, an ultraviolet test signal is turned on by the DEEC. If the DEEC does not receive a LOD flame-on feedback signal within a specific time interval, the test signal is turned off and a system fault flag is set. The DEEC also checks LOD for a flame-off condition.

(2) The mode select switch is cycled from Primary to Secondary to Primary while engine is in augmentation.

b. Engine Symptoms:

(1) Loss of Fast Accel into augmentation.

(2) Reduced automatic augmentor recycle capability. DEEC reattempts augmentation only one time instead of normal three times.

c. Test Stand Observations:

(1) Slower acceleration to Max Aug (No or one recycle prior to augmentor initiation).

(2) Loss of automatic augmentor recycle capability.

(3) System fault light on.

**Table 1. System Fault Code 4160:
LOD Self-Test Failure**

Step	Procedure	Result	Corrective Action
1.	Review event and fault data. Determine if other events or faults are present.	a. Other events or fault codes are present.	a. Troubleshoot other events or fault codes, then go to step 2.
		b. No other events or fault codes are present.	b. Go to step 2.
2.	Review Engine Maintenance Records to determine if operator reported an augmentor anomaly.	a. Operator reported an anomaly.	b. Go to step 4.
		b. Operator did not report an anomaly.	b. Go to step 3.
3.	Review Engine Maintenance Records to determine if this fault has recurred in any of the last three engine runs.	a. Fault recurred.	a. Go to step 4.
		b. Fault did not recur	b. Clear EDU and return engine to service.

Table 2. System Fault Code 4160:
LOD Self-Test Failure

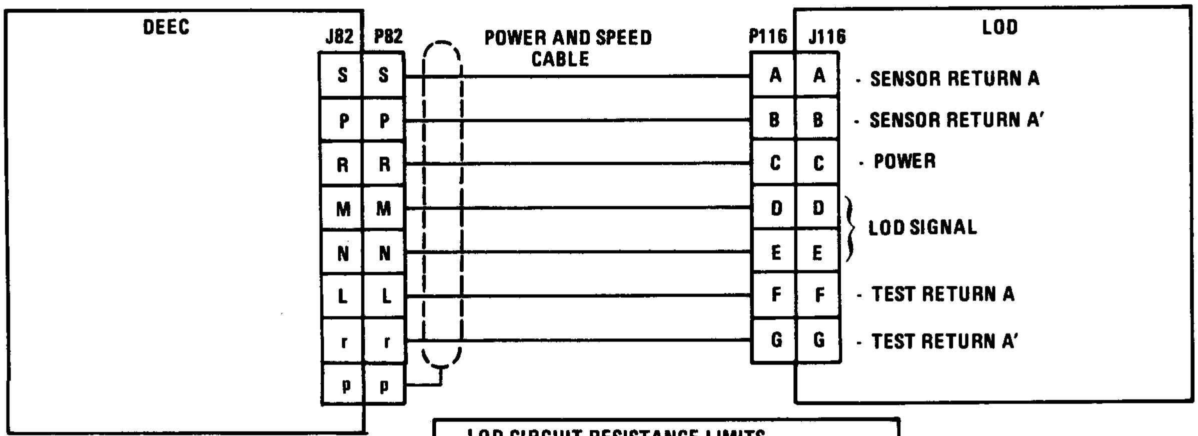
Step	Procedure	Result	Corrective Action
4.	Inspect LOD lens for damage or internal fluid contamination.	a. LOD lens is clear.	a. Go to step 5.
		b. . Damage or contamination noted.	b. Replace LOD. Go to step 7.
5.	Perform the following resistance checks. See figure 1.		
	a. CONN P82 PINS	a.1. Resistance checks within limits:	a.1. Go to step b.
	1. R to p 2. M to p	1. GT 100,000 OHMS 2. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cables.
	b. CONN P82 PINS	b.1. Resistance checks within limits:	b.1. Go to step 5A.
	1. S to R 2. P to R 3. L to R 4. r to R 5. M to N 6. M to R 7. R to GND 8. M to GND	1. LT 10 OHMS 2. LT 10 OHMS 3. LT 15 OHMS 4. LT 15 OHMS 5. 4800 to 7700 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS 8. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Disconnect P116 from LOD and go to step c.
	c. CONN J116 PINS	c.1. Resistance checks within limits:	c.1. Replace power and speed cable.
	1. A to C 2. B to C 3. F to C 4. G to C 5. D to E 6. D to C 7. C to GND 8. D to GND	1. LT 10 OHMS 2. LT 10 OHMS 3. LT 15 OHMS 4. LT 15 OHMS 5. 4800 to 7700 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS 8. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Replace LOD.

Table 2. System Fault Code 4160: LOD Self-Test Failure (continued)

Step	Procedure	Result	Corrective Action
5A.	Check AFC ignition switch circuits. Perform following resistance checks. See figure 2.		
	CONN J104 PINS	a. Resistance checks within limits:	a. Go to step 5B.
	1. A to B 2. D to E	LT 5 OHMS LT 5 OHMS	
		b. Resistance checks out of limits.	b. Replace AFC fill switch and ignition relay module.
5B.	Check ignition harness circuits. Disconnect P104 at AFC, P119 at stator generator, and P26R/P26L at ignition exciters. Perform following resistance checks. See figure 2.		
	CONN PINS	a. Resistance checks within limits:	a. Go to step 6.
	1. P104 A to P26L D 2. B to C 3. D to P26R D 4. E to C	LT 5 OHMS LT 5 OHMS LT 5 OHMS LT 5 OHMS	
		b. Resistance checks out of limits.	b. Replace ignition harness.
6.	IF EAU ID 1-020100 is available, perform LOD test using EMSE.	a. LOD fails test.	a. Replace LOD.
		b. EAU ID 1-020100 is not available or LOD passes test.	b. Go to step 7.

Table 2. System Fault Code 4160: LOD Self-Test Failure (continued)

Step	Procedure	Result	Corrective Action
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
7.	Check that EDU data has been reviewed and stored; then clear EDU data.		
8.	Perform Idle functional check. Check for System Fault Code 4160.	a. System Fault Code 4160 does not repeat.	a. Return engine to service.
		b. System Fault Code 4160 repeats.	b. Replace following components in order, repeating steps 7 and 8 after each replacement until engine operates properly: • LOD • DEEC • Power and Speed Cable

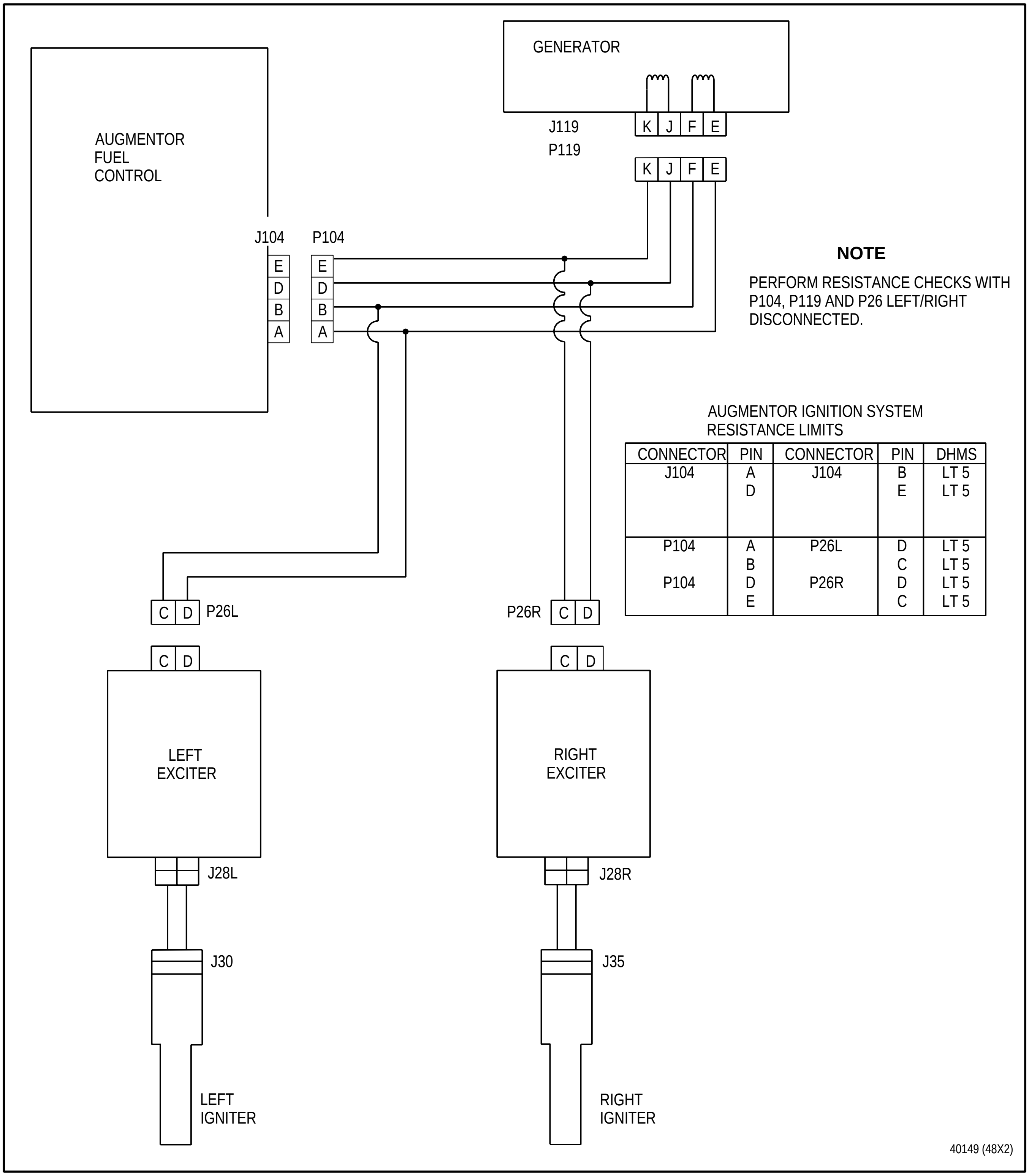


LOD CIRCUIT RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P82	S-R	LT 10
	P-R	LT 10
	L-R	LT 15
	r-R	LT 15
	M-N	4800-7700
	M-R	GT 100,000
	R-GND	GT 100,000
	M-GND	GT 100,000
	R-p	GT 100,000
	M-p	GT 100.000

LOD CIRCUIT RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
J116	A-C	LT 10
	B-C	LT 10
	F-C	LT 15
	G-C	LT 15
	D–E	4800–7700
	D–C	GT 100,000
	C-GND	GT 100,000
	D-GND	GT 100,000

L-208746-3 (38–2)

Figure 1. LOD Circuit



NOTE

PERFORM RESISTANCE CHECKS WITH P104, P119 AND P26 LEFT/RIGHT DISCONNECTED.

AUGMENTOR IGNITION SYSTEM RESISTANCE LIMITS

CONNECTOR	PIN	CONNECTOR	PIN	DHMS
J104	A	J104	B	LT 5
	D		E	LT 5
P104	A	P26L	D	LT 5
	B		C	LT 5
P104	D	P26R	D	LT 5
	E		C	LT 5

Figure 2. Augmentor Ignition System Schematic

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4170: DEEC POWER SUPPLY

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 18

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	14	10	14	17	14
2 - 9	13	11 - 16	13	18 Blank Added	13

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Idle Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4170: DEEC Power Supply	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for DEEC power supply.

2. SYSTEM FAULT CODE 4170: DEEC POWER SUPPLY.

(See Figures 1 through 6 and Table 1.)

a. Cause of Fault:

NOTE

DEEC receives power from engine generator stator power windings.

(1) N2 more than 3000 rpm during check indicating power supply interruption.

(2) Anti-ice valve solenoid (DEEC side), compressor bleed solenoid, mode select solenoid, augmentor ignition relay, LOD power, DEEC test power, or generator stator circuits may cause DEEC malfunction.

b. Engine Symptoms:

(1) Transfer to Secondary Mode.

c. Test Cell Observations:

(1) ENGINE CAUTION light on.

(2) SYSTEM FAULT light on.

(3) SECONDARY CAUTION light on.

(4) Event Code 1200: Auto transfer to Secondary Mode.

Table 1. System Fault Code 4170: DEEC Power Supply

Step	Procedure	Result	Corrective Action
1.	Perform general troubleshooting procedure per WP 501 00.		
2.	Remove P82 and inspect for electrical arcing.	a. Connector serviceable. b. Connector not serviceable.	a. Go to step 3. b. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 11.
3.	Perform following resistance checks (See figure 1): a. CONN P82 PINS 1. T to p	a.1. Resistance check within limits: 1. GT 100,000 OHMS a.2. Resistance check out of limits.	a.1. Go to b. a.2. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 11.
	b. CONN P82 PINS 1. T to U 2. T to V 3. U to V 4. T to GND	b.1. Resistance checks within limits: 1. LT 10 OHMS 2. LT 10 OHMS 3. LT 10 OHMS 4. GT 100,000 OHMS b.2. Resistance checks out of limits.	b.1. Go to step 6. b.2. Go to step 4.
4.	Remove connector P118 and inspect for electrical arcing.	a. Connector serviceable. b. Connector not serviceable.	a. Go to step 5. b. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Replace generator stator. Refer to T.O. 2J-F100-53-4, WP 021 00. Go to step 11.

Table 1. System Fault Code 4170: DEEC Power Supply (continued)

Step	Procedure	Result	Corrective Action
5.	Perform following resistance checks (See figure 1):		
	a. CONN J118	a.1. Resistance checks within limits:	a.1. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 11.
	PINS		
	1. G to H	1. LT 10 OHMS	
	2. G to J	2. LT 10 OHMS	
	3. H to J	3. LT 10 OHMS	
	4. G to GND	4. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace generator stator. Refer to T.O. 2J-F100-53-4, WP 021 00. Go to step 11.

Table 1. System Fault Code 4170: DEEC Power Supply (continued)

Step	Procedure	Result	Corrective Action
6.	Perform following checks on DEEC-activated anti-ice system (See figure 2):		
	a. CONN P85 PINS 1. b to BB 2. H to BB	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace actuator cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 11.
	b. CONN P85 PINS 1. b to H 2. b to GND 3. H to GND	b.1. Resistance checks within limits: 1. 27 to 49 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	b.1. Go to step 7.
		b.2. Resistance checks out of limits.	b.2 Go to c.
	c. CONN J150 PINS 1. A to B 2. A to GND 3. B to GND	c.1. Resistance checks within limits: 1. 27 to 49 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	c.1 Replace actuator cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 11.
		c.2. Resistance checks out of limits.	c.2 Replace anti-ice valve. Refer to T.O. 2J-F100-53-4, WP 039 00. Go to step 11.

Table 1. System Fault Code 4170: DEEC Power Supply (continued)

Step	Procedure	Result	Corrective Action
7.	Check compressor bleed circuit. Perform following resistance checks (See figure 3):		
	a. CONN P83 PINS 1. W TO FF 2. D TO FF	a.1 Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2 Resistance checks out of limits.	a.2. Replace MFC cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 11.
	b. CONN P83 PINS 1. W to D 2. D to GND 3. W to GND	b.1. Resistance checks within limits: 1. 90 to 160 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	b.1. Go to step 8.
		b.2. Resistance checks out of limits.	b.2. Go to c.
	c. CONN J110 PINS 1. A to B 2. B to GND 3. A to GND	c.1. Resistance checks within limits: 1. 90 to 160 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	c.1. Replace MFC cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 11.
		c.2. Resistance checks out of limits.	c.2. Replace MFC compressor bleed solenoid module. Refer to T.O. 2J-F100-53-4, WP 009 00. Go to step 11.

Table 1. System Fault Code 4170: DEEC Power Supply (continued)

Step	Procedure	Result	Corrective Action
	NOTE Disconnect connectors P121 at EDU and P112 at MFC for following resistance checks.		
8.	Check power and speed cable mode solenoid power circuit. Disconnect P82 at DEEC and perform following resistance checks (See figure 4):		
	a. CONN P82 PINS 1. n to cc 2. n to p 3. n to GND	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 11.
	NOTE Disconnect connectors P121 at EDU and P82 at DEEC for following resistance checks.		
	b. CONN P112 PINS 1. J to K	b.1. Resistance checks within limits: 1. GT 100,000 OHMS	b.1. Install P121 and P82. Go to c.
		b.2. Resistance checks out of limits.	b.2. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 11.
	c. CONN J112 PINS 1. J to K 2. J to GND	c.1. Resistance checks within limits: 1. 21 to 42 OHMS 2. GT 100,000 OHMS	c.1. Install P112. Go to step 9.
		c.2. Resistance checks out of limits.	c.2. Replace mode solenoid. Refer to T.O. 2J-F100-53-4, WP 009 00. Go to step 11.

Table 1. System Fault Code 4170: DEEC Power Supply (continued)

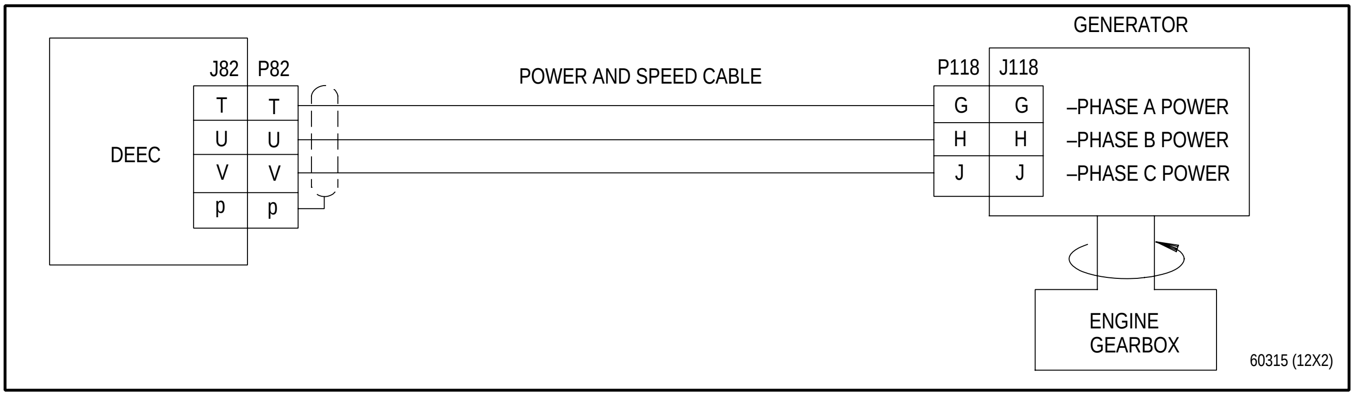
Step	Procedure	Result	Corrective Action
9.	Check AFC ignition relay circuit. Perform following resistance checks. (See figure 5):		
	a. CONN P84 PINS 1. CC to AA 2. DD to AA	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace augmentor fuel control cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 11.
	b. CONN P84 PINS 1. CC to DD 2. CC to GND 3. DD to GND	b.1. Resistance checks within limits: 1. 200 to 400 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	b.1. Go to step 10.
		b.2. Resistance checks out of limits.	b.2. Remove P97 connector from ignition relay assembly. Go to c.
	c. CONN J97 PINS 1. A to B 2. A to GND 3. B to GND	c.1. Resistance checks within limits: 1. 200 to 400 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	c.1. Replace augmentor fuel control cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 11.
		c.2. Resistance checks out of limits.	c.2. Replace AFC ignition relay assembly. Refer to T.O. 2J-F100-53-4, WP 010 00. Go to step 11.

Table 1. System Fault Code 4170: DEEC Power Supply (continued)

Step	Procedure	Result	Corrective Action
	NOTE Disconnect EMSE from J77 for following resistance checks.		
10.	Check DEEC test power circuit. Disconnect P82 at DEEC. Perform following resistance checks at P82. (See figure 6): a. CONN P82 PINS 1. G to GND 2. G to p 3. G to s	a. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	a. Install P82 and EMSE. Go to step 11.
		b. Resistance checks out of limits.	b. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 11.
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
11.	Check that EDU data has been reviewed and saved per WP 651 00; then clear EDU data per WP 656 00. Go to step 12.		

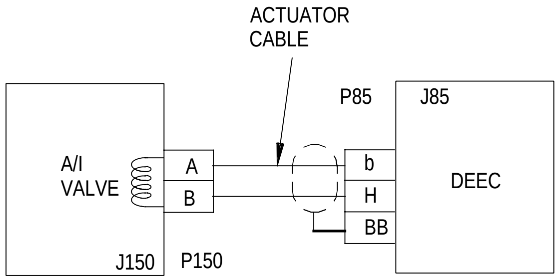
Table 1. System Fault Code 4170: DEEC Power Supply (continued)

Step	Procedure	Result	Corrective Action
12.	Perform Idle functional test per WP 216 00. Review EDU data for system fault code per WP 651 00.	a. System Fault Code 4170 does not repeat.	a. Return engine to service.
		b. System Fault Code 4170 repeats.	b. Replace components in following order until engine operates properly: Refer to T.O. 2J-F100-53-4 • DEEC WP 007 00. • Power and speed cable WP 019 00. • MFC mode solenoid and screen assembly WP 009 00. • Compressor bleed solenoid WP 009 00. • Anti-ice valve WP 039 00. • Augmentor ignition relay assembly WP 010 00. • Actuator cable WP 019 00. • Gas generator control cable WP 019 00. • AFC cable WP 019 00. • Generator stator WP 021 00. • Generator rotor WP 022 00. Go to step 13.
13.	Clear EDU data per WP 656 00; and return to step 12.		



CONNECTORS	PINS	OHMS
P82	T to U	LT 10
	T to V	LT 10
	U to V	LT 10
	T to GND	GT 100,000
	T to p	GT 100,000
J118	G to H	LT 10
	G to J	LT 10
	H to J	LT 10
	G to GND	GT 100,000

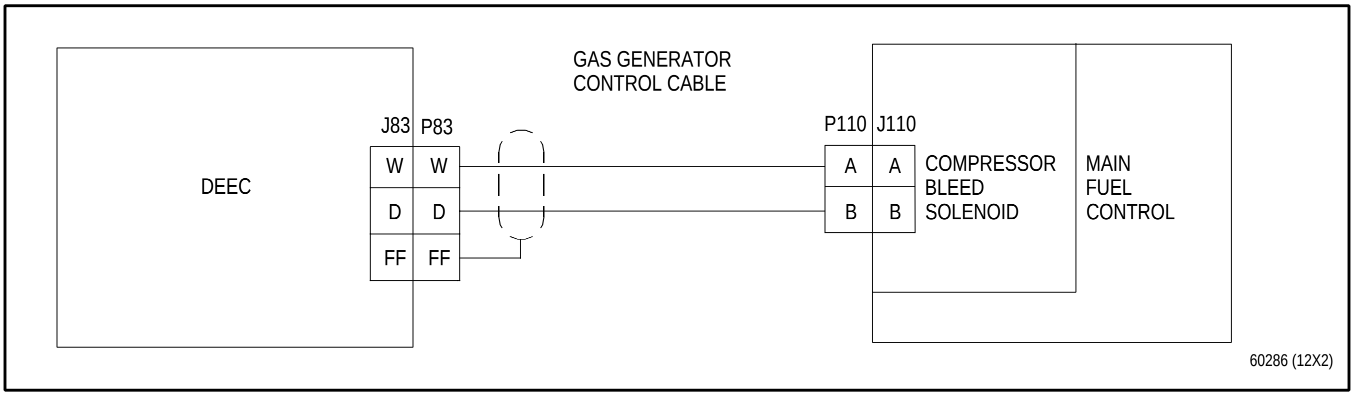
Figure 1. Generator Power Winding Circuit



ANTI-ICE VALVE SOLENOID RESISTANCE LIMITS

CONNECTORS	PINS	OHMS
P85	b to BB	GT 100,000
	H to BB	GT 100,000
	b to H	27 to 49
	b to GND	GT 100,000
	H to GND	GT 100,000
J150	A to B	27 to 49
	A to GND	GT 100,000
	B to GND	GT 100,000

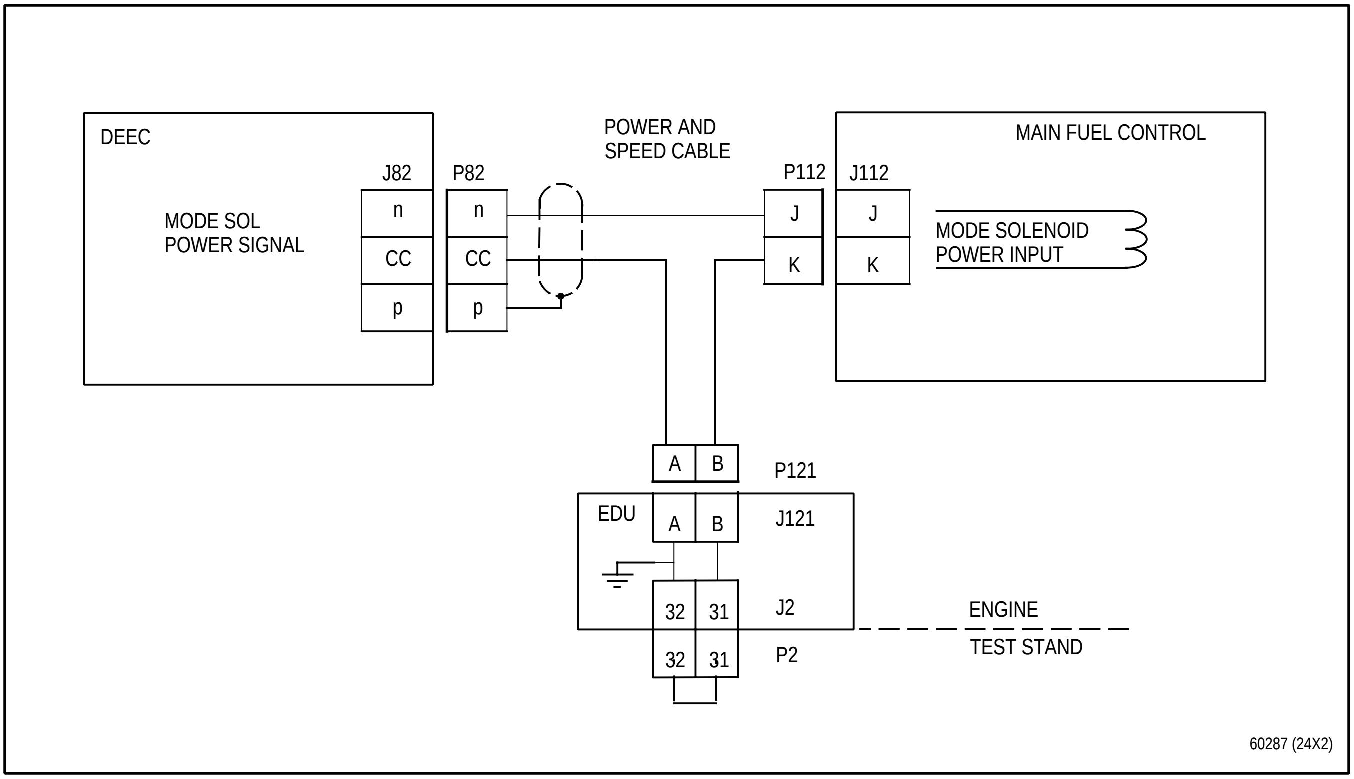
Figure 2. F100-PW-229 DEEC Anti-Ice System



COMPRESSOR BLEED SOLENOID RESISTANCE LIMIT

CONNECTORS	PINS	OHMS
P83	W to D	90 to 160
	D to GND	GT 100,000
	W to GND	GT 100,000
	W to FF	GT 100,000
	D to FF	GT 100,000
J110	A to B	90 to 160
	B to GND	GT 100,000
	A to GND	GT 100,000

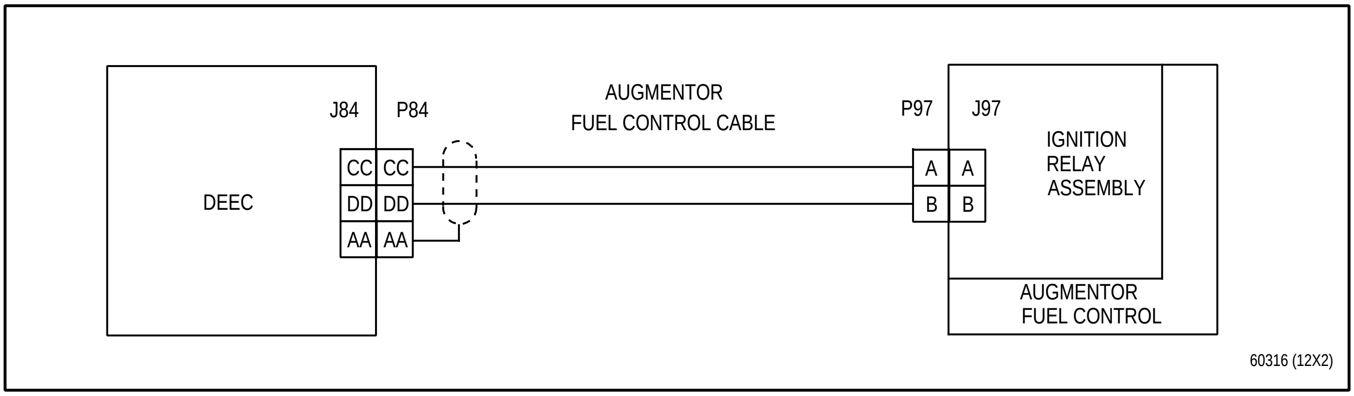
Figure 3. MFC Compressor Bleed Solenoid Circuit



MODE SOLENOID POWER CIRCUIT RESISTANCE LIMITS

CONNECTORS	PINS	OHMS
NOTE Disconnect P121 from EDU and P112 from MFC for these resistance checks.		
P82	n to CC	GT 100,000
	n to p	GT 100,000
	n to GND	GT 100,000
NOTE Disconnect P121 and P82 for this resistance check.		
P112	J to K	GT 100,000
NOTE Connect P121 and P82 for these resistance checks.		
J112	J to K	21 to 42
	J to GND	GT 100,000

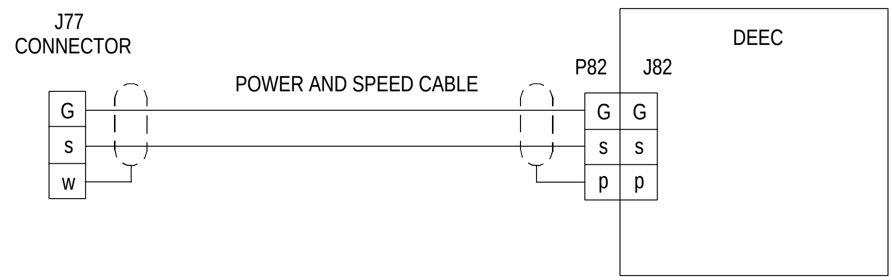
Figure 4. Mode Solenoid Circuit Schematic



IGNITION RELAY RESISTANCE LIMIT

CONNECTORS	PINS	OHMS
P84	CC to DD	200 to 400
	CC to GND	GT 100,000
	DD to GND	GT 100,000
	CC to AA	GT 100,000
	DD to AA	GT 100,000
J97	A to B	200 to 400
	A to GND	GT 100,000
	B to GND	GT 100,000

Figure 5. Augmentor Fuel Control Ignition Relay Circuit



DEEC TEST POWER CIRCUIT RESISTANCE LIMITS

CONNECTORS	PINS	OHMS

NOTE

Disconnect EMSE from J77 and P82 from DEEC for this check.

CONNECTORS	PINS	OHMS
P82	G to GND	GT 100,000
	G to P	GT 100,000
	G to s	GT 100,000

Figure 6. DEEC Test Power Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4180:
Mn SIGNAL

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	18				
3 - 7	17				
8 Blank	17				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Idle Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	SYSTEM FAULT CODE 4180: Mn INPUT TO DEEC OUT OF RANGE	
	OHMMETER	PSM-6 OR EQUIVALENT

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for Mn signal.

b. The DEEC measures Mach numbers (Mn) in decimal counts. The normal Mn range is 0.15 to 2.80 (214 to 3564 octal). A Mn outside normal range is held in range until inputs limits are reached.

2. SYSTEM FAULT CODE 4180: Mn INPUT TO DEEC OUT OF RANGE.

(See Figure 1 and Table 1.)

a. Cause of Fault.

(1) One or more of the following conditions present when IAR switch is moved from off to reset:

(a) No Mn signal being received by DEEC.

(b) Mn signal out of range (Less than 100 counts [144 octal] or more than 1950 counts [3636 octal]).

(c) Mn rate of change exceeds allowable limits (F-15 only).

(2) One or more above conditions occurred in F-15 asymmetric thrust departure prevention (ATDP) region (F-15 only).

b. Engine Symptoms.

(1) Supersonic: Loss of Mn lock-out protection causing potential stall during Decel

(2) Subsonic: None

(3) Air Start: Potential increase in start time

c. Test Stand Observations.

(1) System fault light on

(2) Aug/Mn light on

(3) Engine caution light on

Table 1. System Fault Code 4180:
Mn Input To DEEC Out Of Range

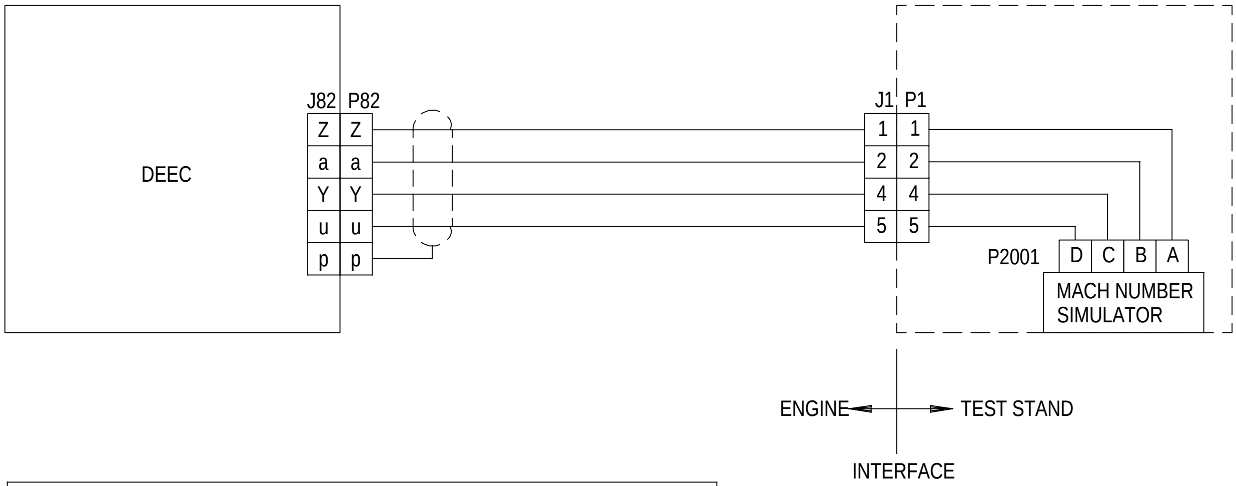
Step	Procedure	Result	Corrective Action
1.	Ensure test stand Mn simulator power switch is ON. Check that Mn simulator is 0214 Octal.	a. Mn simulator is 0214 Octal. b. Mn simulator Mn is not 0214 Octal.	a. Go to step 2. b. Set Octal to 0214. If problem still exists, go to step 2.
2.	Disconnect P82 from DEEC and P1 from J1. Perform the following resistance/continuity checks. See figure 1.		
	a. CONN P82 PINS 1. Z to p 2. a to p 3. Y to p 4. u to p	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	a.1. Go to step b.
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 4.
	b. CONN P82 PINS 1. Z to GND 2. a to GND 3. Y to GND 4. u to GND	b.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	b.1. Go to step c.
		b.2. Resistance checks out of limits:	b.2. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 4.

Table 1. System Fault Code 4180: Mn Input To DEEC Out Of Range (continued)

Step	Procedure	Result	Corrective Action
2. (cont'd)	c. CONN P82 to CONN J1 PINS PINS	c.1. Continuity checks within limits:	c.1. Go to step 3. Install P82 on DEEC.
	5. Z 1	5. LT 5 OHMS	
	6. a 2	6. LT 5 OHMS	
	7. Y 4	7. LT 5 OHMS	
	8. u 5	8. LT 5 OHMS	
		c.2. Continuity checks out of limits.	c.2. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 4.
3.	Disconnect test stand P2001 or Mn simulator. Perform following resistance checks. See figure 1.		
	a. CONN P1 PINS	a.1. Resistance checks within limits:	a.1. Install P1 on J1 and P2001 to Mn simulator. Go to step 4.
	1. 1 to GND	1. GT 100,000 OHMS	
	2. 2 to GND	2. GT 100,000 OHMS	
	3. 4 to GND	3. GT 100,000 OHMS	
	4. 5 to GND	4. GT 100,000 OHMS	
	5. 1 to 2	5. GT 100,000 OHMS	
	6. 4 to 5	6. GT 100,000 OHMS	
		a.2. Resistance checks out of limits:	a.2. Repair test stand wiring. Refer to T.O. 33D4-6-685-1. Go to step 4.

**Table 1. System Fault Code 4180:
Mn Input To DEEC Out Of Range (continued)**

Step	Procedure	Result	Corrective Action
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
4.	Check that EDU data has been reviewed and stored per WP 651 00; then clear EDU data per WP 656 00. Go to step 5.		
	NOTE Advisory code 5180 (Mn input to DEEC, short term out of range) present during EDU data review in step 5 indicates Mn anomaly still exist.		
5.	Perform IDLE functional check. Refer to WP 216 00. Review EDU data for system fault codes 4180 or 5180 per WP 651 00.	a. Fault codes 4180 and 5180 do not repeat.	a. Return engine to service.
		b. Fault codes 4180 or 5180 repeat.	b. Replace components in following order one at a time and go to step 6. • Mach number simulator. Refer to T.O. 33D4-6-523-1. • DEEC. Refer to T.O. 2J-F100-53-4, WP 007 00. • Power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. • Test stand cable. Refer to T.O. 33D4-6-685-1.
6.	Clear EDU data per WP 656 00 and return to step 5.		



POWER AND SPEED CABLE Mn RESISTANCE LIMITS				
CONNECTOR	PINS	CONNECTOR	PINS	OHMS
P82	Z–GND	J1	1–GND	GT 100,000
	a–GND		2–GND	GT 100,000
	Y–GND		4–GND	GT 100,000
	u–GND		5–GND	GT 100,000
	Z–p			GT 100,000
	a–p			GT 100,000
	Y–p			GT 100,000
	u–p			GT 100,000
POWER AND SPEED CABLE CONTINUITY LIMITS				
CONNECTOR	PINS	CONNECTOR	PINS	OHMS
P82	Z	J1	1	LT 5
	a		2	LT 5
	Y		4	LT 5
	u		5	LT 5

72710 (36X2)

Figure 1. Power and Speed Cable Mn Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4190 AND 4191: AIRCRAFT (AC) SWITCH

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	28	5 - 6	0	8 - 11	0
2 - 3	0	7	28	12 Blank	0
4	28				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Test Requirements	WP 206 00
Secondary Functional Check	WP 215 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4190: Mode Select Switch/Solenoid Malfunction	
	Volt/Ohmmeter	PSM-6 or equivalent
3	System Fault Code 4191: Fault Reset Switch Malfunction	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for aircraft switch.

2. SYSTEM FAULT CODE 4190: AIRCRAFT MODE SELECT SWITCH/SOLENOID MALFUNCTION.

(See Figure 1 and Table 1.)

NOTE

If this fault occurs after first start following engine fuel system maintenance, preservation, or initial assembly, refer to WP 206 00 for corrective action.

a. Cause of Fault.

(1) Mode solenoid windings, feedback switch, signal request, fuel system, or transfer valve. Malfunction when:

(a) Primary mode is requested by DEEC and Mode Position Signal indicates SEC mode

(b) SEC mode is requested by DEEC and Mode Position Signal indicates Primary mode

b. Engine Symptoms.

(1) Mode select switch is in Primary mode, but engine is in SEC mode.

(2) Mode select switch is in SEC mode, but engine is in Primary mode.

c. Test Stand Observations.

(1) System fault light on

(2) Requested mode of operation does not match mode indication

(3) SEC caution light on

(4) Event Code 1200: Auto transfer to SEC mode present (EDU ID 1-020100 and subsequent).

**Table 1. System Fault Code 4190:
Aircraft Mode Select Switch/Solenoid Malfunction**

Step	Procedure	Result	Corrective Action
1.	Check MFC mode solenoid (No. 1) switch. Perform the following resistance checks. See figure 1.		
	a. CONN P82 PINS 1. FF to p 2. GG to p	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to step b.
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable.
	b. CONN P82 PINS 1. FF to GG 2. FF to GND 3. GG to GND	b.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	b.1. Disconnect P2 connector from EDU. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Disconnect P112 connector from MFC. Go to step c.
	c. CONN J112 PINS 1. A to B 2. A to GND 3. B to GND	c.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	c.1. Replace power and speed cable.
		c.2. Resistance checks out of limits.	c.2. Replace MFC.
2.	Check test stand power supply indicator. Perform the following voltmeter checks:		
	CONN P2 PINS 1. 34 to 35	a. Voltmeter check within limits: 1. 24 to 30 VDC	a. Go to step 3.
		b. Voltmeter check out of limits.	b. Repair test stand power supply to SEC mode solenoid.

Table 1. System Fault Code 4190:
Aircraft Mode Select Switch/Solenoid Malfunction (continued)

Step	Procedure	Result	Corrective Action
3.	Check mode select circuit. Perform the following resistance checks. (Ensure P112 connected.)		
	a. CONN P82 PINS	a.1. Resistance checks within limits:	a.1. Go to step b.
	MODE SELECT - PRIM		
	1. n to p	1. GT 100,000 OHMS	
	2. CC to p	2. GT 100,000 OHMS	
	3. k to p	3. GT 100,000 OHMS	
	4. BB to p	4. GT 100,000 OHMS	
	MODE SELECT - SEC		
	5. n to p	5. GT 100,000 OHMS	
	6. CC to p	6. GT 100,000 OHMS	
	7. k to p	7. GT 100,000 OHMS	
	8. BB to p	8. GT 100,000 OHMS	
		a.2. Resistance checks out of limits	a.2. Replace power and speed cable.
	b. CONN P82 PINS	b.1. Resistance checks within limits:	b.1. Go to step 4.
	MODE SELECT - PRIM		
	1. n to CC	1. 21 to 42 OHMS	
	2. n to GND	2. GT 100,000 OHMS	
	MODE SELECT - SEC		
	3. n to CC	3. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Go to step c.
	c. CONN P2 PINS	c.1. Resistance checks within limits:	c.1. Go to step d.
	MODE SELECT - PRIM		
	1. 31 to 32	1. LT 5 OHMS	
	2. 31 to GND	2. GT 100,000 OHMS	
	MODE SELECT - SEC		
	3. 31 to 32	3. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Repair or replace test stand as required.

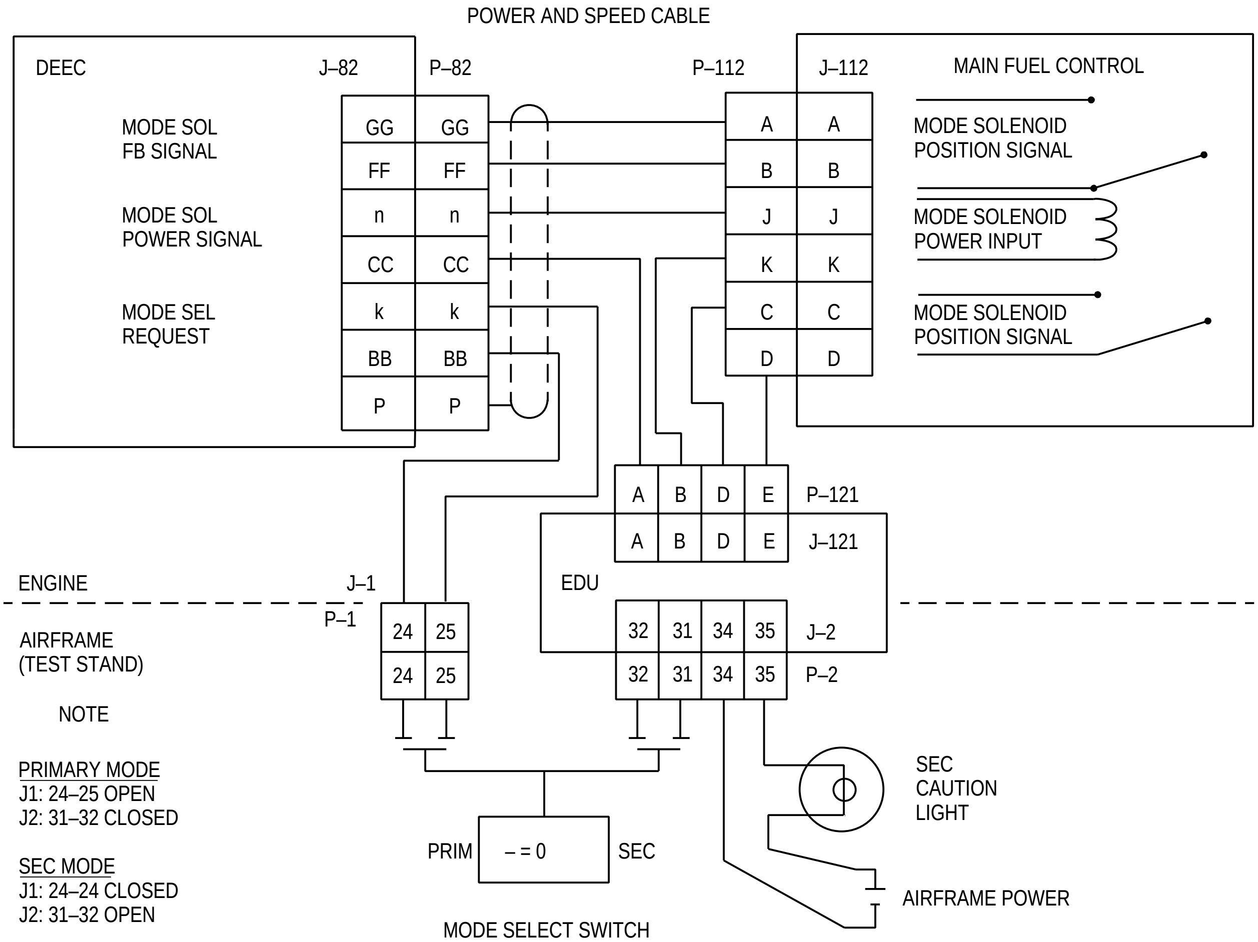
**Table 1. System Fault Code 4190:
Aircraft Mode Select Switch/Solenoid Malfunction (continued)**

Step	Procedure	Result	Corrective Action
3 (cont.)	d. CONN PINS J112 1. J to K 2. J to GND	d.1. Resistance checks within limits: 1. 21 to 42 OHMS 2. GT 100,000 OHMS	d.1. Go to step e.
		d.2. Resistance checks out of limits.	d.2. Replace MFC mode solenoid switch assembly.
	e. Perform the following continuity checks: CONN PIN CONN PIN 1. J2 31 J121 B 2. J2 32 J121 A	e.1. Continuity checks within limits: 1. LT 5 OHMS 2. LT 5 OHMS	e.1. Replace power and speed cable.
		e.2. Continuity checks out of limits.	e.2. Replace EDU.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
4.	Check that EDU data has been reviewed and stored; then clear EDU data.		
5.	Perform SEC functional check. Check for System Fault Code 4190.	a. System Fault Code 4190 does not repeat.	a. Return engine to service.
		b. System Fault Code 4190 repeats.	b.1 Replace MFC mode solenoid and screen assembly.
			b.2. If fault code 4190 repeats, replace MFC.



MODE SELECT SWITCH	PINS (P–82)	PINS (J–112)	OHMS
	FF–GG FF–GND GG–GND	A–B A–GND B–GND J–K J–GND	GT 100,000 GT 100,000 GT 100,000 21–42 GT 100,000
PRIM PRIM SEC PRIM PRIM SEC	PINS (P–82)	PINS (P–2)	21–42
	n–CC n–GND n–CC	31–32 31–GND 31–32	GT 100,000 GT 100,000 LT 5 GT 100,000 GT 100,000

109528 (48X2)

Figure 1. Mode Select Switch/Solenoid Circuit Schematic

3. SYSTEM FAULT CODE 4191: FAULT RESET SWITCH MALFUNCTION.
(See Figure 2 and Table 2.)

NOTE

Fault reset switch is a momentary-closure switch.

a. Cause of Fault.

(1) Fault reset switch remained closed for at least 20 seconds.

b. Engine Symptoms.

(1) No response to fault reset input

c. Test Stand Observations.

(1) Augmentor/Mn fault light will not go out with fault reset switch

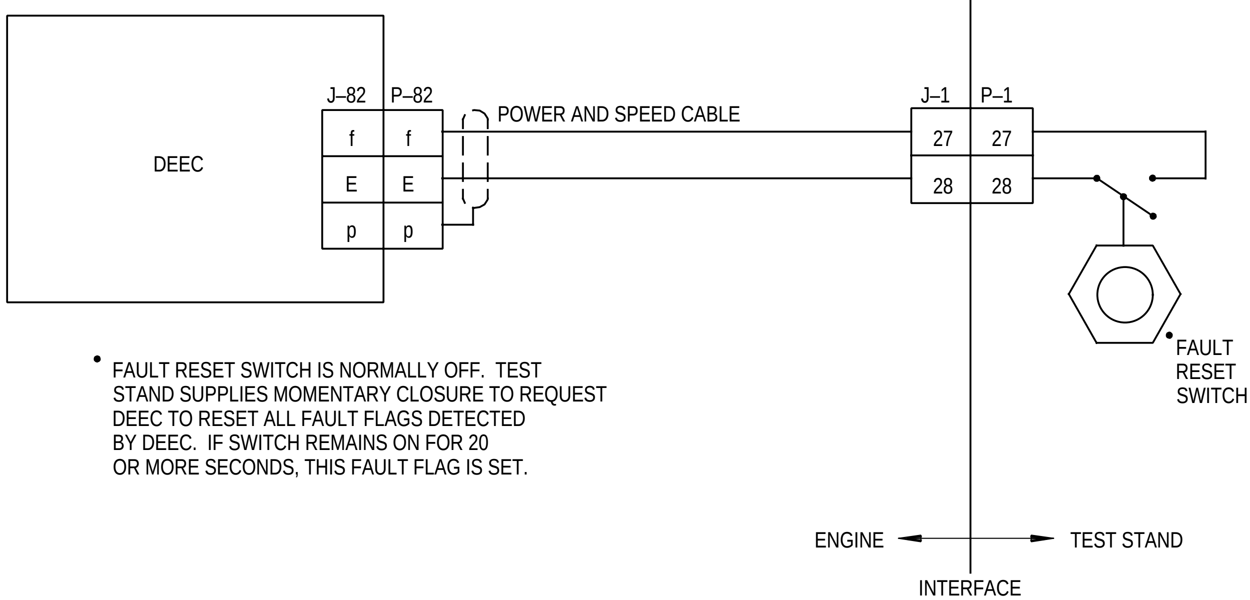
(2) System fault light on

Table 2. System Fault Code 4191: Fault Reset Switch Malfunction

Step	Procedure	Result	Corrective Action
1.	Perform the following resistance checks. See figure 2.		
	a. CONN P82 PINS	a.1. Resistance checks within limits:	a.1. Go to step b.
	1. f to p 2. E to p	1. GT 100,000 OHMS 2. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable.
	b. CONN P82 PINS	b.1. Resistance checks within limits:	b.1. Go to step 2.
	FAULT RESET SWITCH - ON*		
	1. f to E	1. LT 5 OHMS	
	FAULT RESET SWITCH - OFF		
	2. f to E 3. f to GND 4. E to GND	2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Disconnect P1 from J1 connector. Go to step c.
	c. CONN P1 PINS	c.1. Resistance checks within limits:	c.1. Replace power and speed cable.
	FAULT RESET SWITCH - ON*		
	1. 27 to 28	1. LT 5 OHMS	
	FAULT RESET SWITCH - OFF		
	2. 27 to 28 3. 27 to GND 4. 28 to GND	2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Repair or replace test stand wiring as required.
	*Momentary switch must be held down to remain ON.		

**Table 2. System Fault Code 4191:
Fault Reset Switch Malfunction (continued)**

Step	Procedure	Result	Corrective Action
NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.			
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform idle functional check. Check for System Fault Code 4191. Replace components in the following order until engine operates properly:	a. System Fault Code 4191 does not repeat.	a. Return engine to service.
	• DEEC • Power and Speed Cable	b. System Fault Code 4191 repeats.	b. Replace next component. Repeat steps 2 and 3.



FAULT RESET SWITCH RESISTANCE LIMITS

PINS (P–82)	PINS (P–1)	OHMS
f–E	27–28	LT5 (ON)
f–E	27–28	GT 100,000 (OFF)
f–GND	27–GND	GT 100,000 (OFF)
E–GND	28–GND	GT 100,000 (OFF)
f–p		GT 100,000 (OFF)
E–p		GT 100,000 (OFF)

KN21 (37X2)

Figure 2. Fault Reset Switch Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4192:
AIRCRAFT IDENTIFICATION CIRCUIT

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4192: Aircraft Identification Circuit	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for aircraft identification circuit.

b. Two redundant circuits in the aircraft J1 signal DEEC to indicate aircraft configuration (F-15 or F-16). For F-15, both circuits are open. For F-16, both circuits are closed.

2. SYSTEM FAULT CODE 4192: AIRCRAFT IDENTIFICATION CIRCUIT.

(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) Aircraft identification circuit to DEEC detected aircraft/engine misconfiguration.

b. Engine Symptoms:

(1) No effect if malfunction detected:

(a) During start, DEEC assumes F-15 configuration

(b) While engine operating, DEEC retains last input

c. Test Cell Observation:

(1) SYSTEM FAULT light on

Table 1. System Fault Code 4192: Aircraft Identification Circuit

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks. Note position of aircraft ID switch (See figure 1.):		
	a. CONN P82 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	A/C ID SWITCH		
	1. t to p	1. GT 100,000 OHMS	
	2. z to p	2. GT 100,000 OHMS	
	3. X to p	3. GT 100,000 OHMS	
	4. AA to p	4. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable.
	b. CONN P82 PINS	b.1. Resistance checks within limits:	b.1. Go to step 2.
	A/C ID SWITCH: F-15		
	1. t to X	1. GT 100,000 OHMS	
	2. z to AA	2. GT 100,000 OHMS	
	3. t to GND	3. GT 100,000 OHMS	
	4. X to GND	4. GT 100,000 OHMS	
	5. z to GND	5. GT 100,000 OHMS	
	6. AA to GND	6. GT 100,000 OHMS	
	A/C ID SWITCH: F-16		
	7. t to X	7. LT 5 OHMS	
	8. z to AA	8. LT 5 OHMS	
	9. t to GND	9. GT 100,000 OHMS	
	10. z to GND	10. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Disconnect P1 from J1. Go to c.

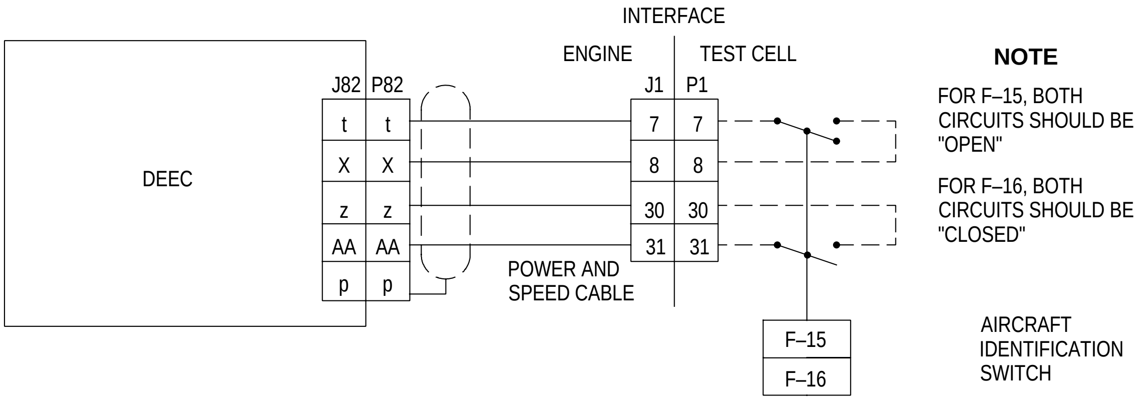
Table 1. System Fault Code 4192: Aircraft Identification Circuit (continued)

Step	Procedure	Result	Corrective Action
1. (cont.)	c. CONN P1 PINS A/C ID SWITCH: F-15 1. 7 to 8 2. 30 to 31 3. 7 to GND 4. 8 to GND 3 5. 0 to GND 6. 31 to GND A/C ID SWITCH: F-16 7. 7 to 8 8. 30 to 31 9. 7 to GND 10. 30 to GND	c.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS 7. LT 5 OHMS 8. LT 5 OHMS 9. GT 100,000 OHMS 10. GT 100,000 OHMS	c.1. Replace power and speed cable.
		c.2. Resistance checks out of limits.	c.2. Repair test cell wiring as required.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear data.		
3.	Perform IDLE functional check. Check for System Fault Code 4192. Replace components in following order until engine operates properly:	a. System Fault Code 4192 does not repeat.	a. Return engine to service.
	• DEEC • Power and speed cable	b. System Fault Code 4192 repeats.	b. Replace next component. Repeat steps 2 and 3.



A/C ID SWITCH RESISTANCE LIMITS	
PINS (P82)	OHMS
t–p	GT 100,000
z–p	GT 100,000
X–p	GT 100,000
AA–p	GT 100,000

F–15 POSITION RESISTANCE LIMITS		
PINS (P82)	PINS (P1)	OHMS
t–X	7–8	GT 100,000
z–AA	30–31	GT 100,000
t–GND	7–GND	GT 100,000
X–GND	8–GND	GT 100,000
z–GND	30–GND	GT 100,000
AA–GND	31–GND	GT 100,000

F–16 POSITION RESISTANCE LIMITS		
PINS (P82)	PINS (P1)	OHMS
t–X	7–8	LT5
z–AA	30–31	LT5
t–GND	7–GND	GT 100,000
z–GND	30–GND	GT 100,000

JN77X1 (44X2)

Figure 1. Aircraft Identification Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4194:
(PILOT) DATA COLLECT SWITCH CIRCUIT

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 5	0				
6 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4194: (Pilot) Data Collect Switch Circuit	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for (pilot) data collect switch circuit.

2. SYSTEM FAULT CODE 4194: PILOT DATA SWITCH

(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) (Pilot) data collect switch closed for more than 10 seconds. Pilot can signal EDU to record transient data by closing switch, providing momentary closure signal to EDU.

b. Engine Symptoms:

(1) None

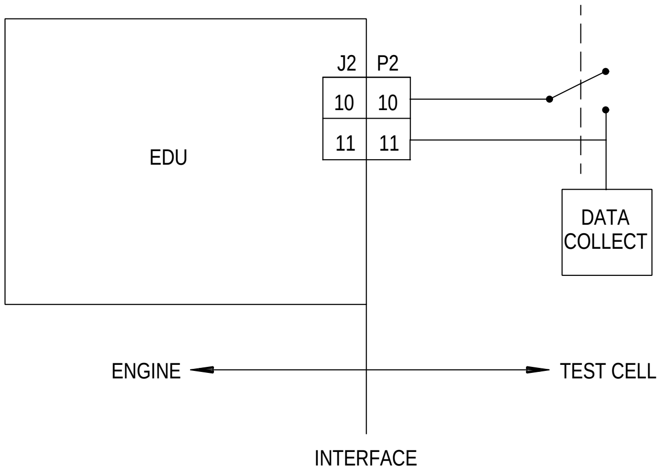
(2) EDU data not recorded when requested

c. Test Cell Observations:

(1) SYSTEM FAULT light on

Table 1. System Fault Code 4194: (Pilot) Data Collect Switch Circuit

Step	Procedure	Result	Corrective Action
1.	Check test cell data collect switch circuit. Perform following resistance checks (See figure 1): CONN P2 PINS DATA COLLECT SWITCH - ON 1. 10 to 11 DATA COLLECT SWITCH - OFF 2. 10 to 11 3. 10 to GND 4. 11 to GND	a. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	a. Go to step 2.
		b. Resistance checks out of limits.	b. Repair test cell wiring to data switch.
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform IDLE functional check. Check for System Fault Code 4194, and proper engine operation.	a. System Fault Code 4194 does not repeat and engine operates properly.	a. Return engine to service.
		b. System Fault Code 4194 repeats.	b. Replace EDU and repeat steps 2 and 3.



NOTE

PILOT PROVIDES MOMENTARY CLOSURE OF SWITCH TO SIGNAL EDU DATA STORAGE.

(PILOT) DATA COLLECT SWITCH RESISTANCE LIMITS	
PINS (P2)	OHMS
10–11	LT 5 (ON)
10–11	GT 100,000 (OFF)
10–GND	GT 100,000
11–GND	GT 100,000

JN78X1 (24X2)

Figure 1. (Pilot) Data Collect Switch Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4200 AND 4201: RESOLVER EXCITATION CIRCUIT

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 18

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 17	0				
18 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Acceleration/Deceleration Checks	WP 213 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4200: Resolver Circuit A	
	Ohmmeter	PSM-6 or equivalent
3	System Fault Code 4201: Resolver Circuit B	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for resolver excitation circuit.

2. SYSTEM FAULT CODE 4200: RESOLVER CIRCUIT A.
(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) Excitation voltage to CIVV, AFC duct, AFC core, AFC SVP, MFC M/V No. 1, MFC RCVV No. 1, and MFC PLA No. 1 resolvers fails range check due to malfunctioning DEEC power supply or short-loading power supply.

b. Engine Symptoms:

(1) CIVVs retract

(2) Augmentation inhibited

(3) Transfer to Secondary Mode if System Fault Code 4201 also present

c. Test Cell Observations:

(1) Augmentation inhibited

(2) Low N2 rpm and FTIT at Intermediate (MIL)

(3) AUGMENTOR MN FAULT light on

(4) ENGINE CAUTION light on

(5) SYSTEM FAULT light on

(6) EDU Event Code 1220: Augmentation inhibited

d. Additional Test Cell Observations (System Fault Codes 4200 and 4201 present):

(1) SECONDARY CAUTION light on

(2) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 1. System Fault Code 4200: Resolver Circuit A

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks (See figure 1):		
	a. CONN P83 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	1. R to FF	1. GT 100,000 OHMS	
	2. p to FF	2. GT 100,000 OHMS	
	3. M to FF	3. GT 100,000 OHMS	
	4. y to FF	4. GT 100,000 OHMS	
		a.2 Resistance checks out of limits.	a.2. Replace MFC cable.
	b. CONN P84 PINS	b.1. Resistance checks within limits:	b.1. Go to c.
	1. X to AA	1. GT 100,000 OHMS	
	2. Z to AA	2. GT 100,000 OHMS	
	3. q to AA	3. GT 100,000 OHMS	
	4. s to AA	4. GT 100,000 OHMS	
	5. EE to AA	5. GT 100,000 OHMS	
	6. GG to AA	6. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Replace AFC cable.
	c. CONN P85 PINS	c.1. Resistance checks within limits:	c.1. Go to d.
	1. L to BB	1. GT 100,000 OHMS	
	2. K to BB	2. GT 100,000 OHMS	
	3. P to BB	3. GT 100,000 OHMS	
	4. n to BB	4. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Replace actuator cable.
	d. CONN P83 PINS	d.1. Resistance checks within limits:	d.1. Go to step 2.
	(MFC MV1)		
	1. R to S	1. 43 to 117 OHMS	
	2. p to n	2. 53 to 131 OHMS	
	3. p to T	3. 53 to 131 OHMS	
	4. R to p	4. GT 100,000 OHMS	
	5. R to GND	5. GT 100,000 OHMS	
	6. p to GND	6. GT 100,000 OHMS	
	(MFC PLA1)		
	7. M to N	7. 43 to 117 OHMS	
	8. y to g	8. 53 to 131 OHMS	
	9. y to h	9. 53 to 131 OHMS	
	10. M to y	10. GT 100,000 OHMS	
	11. M to GND	11. GT 100,000 OHMS	
	12. y to GND	12. GT 100,000 OHMS	

Table 1. System Fault Code 4200: Resolver Circuit A (continued)

Step	Procedure	Result	Corrective Action
1.d. (cont.)	CONN P84 PINS		
	(AFC CMV)		
	13. X to Y	13. 43 to 117 OHMS	
	14. Z to u	14. 53 to 131 OHMS	
	15. Z to a	15. 53 to 131 OHMS	
	16. X to Z	16. GT 100,000 OHMS	
	17. X to GND	17. GT 100,000 OHMS	
	18. Z to GND	18. GT 100,000 OHMS	
	(AFC DMV)		
	19. q to r	19. 43 to 117 OHMS	
	20. s to U	20. 53 to 131 OHMS	
	21. s to V	21. 53 to 131 OHMS	
	22. q to s	22. GT 100,000 OHMS	
	23. q to GND	23. GT 100,000 OHMS	
	24. s to GND	24. GT 100,000 OHMS	
	CONN P85 PINS		
	(CIVV)		
	31. L to M	31. 43 to 117 OHMS	
	32. K to f	32. 53 to 131 OHMS	
	33. K to g	33. 53 to 131 OHMS	
	34. L to K	34. GT 100,000 OHMS	
	35. L to GND	35. GT 100,000 OHMS	
	36. K to GND	36. GT 100,000 OHMS	
	(LH RCVV)		
	37. P to R	37. 43 to 117 OHMS	
	38. m to n	38. 53 to 131 OHMS	
	39. m to AA	39. 53 to 131 OHMS	
	40. P to m	40. GT 100,000 OHMS	
	41. P to GND	41. GT 100,000 OHMS	
	42. m to GND	42. GT 100,000 OHMS	

Table 1. System Fault Code 4200: Resolver Circuit A (continued)

Step	Procedure	Result	Corrective Action
1.d. (cont.)		d.2. Resistance checks out of limits.	d.2. Perform resistance checks in e. only for those components found out of limits in d. Disconnect following connectors as required: Component/ Module — CONN MFC MV — P109 MFC PLA — P107 AFC CMV — P101 AFC DMV — P103 AFC SSV — P99 CIVV — P93 LH RCVV — P89
	e. CONN J109 — PINS	e.1. Resistance checks within limits:	e.1.a. (Checks 1 through 12) Replace MFC cable.
	(MFC MV1)		
	1. A to B	1. 43 to 117 OHMS	
	2. C to D	2. 53 to 131 OHMS	
	3. C to E	3. 53 to 131 OHMS	
	4. A to C	4. GT 100,000 OHMS	
	5. A to GND	5. GT 100,000 OHMS	
	6. C to GND	6. GT 100,000 OHMS	
	CONN J107 — PINS		
	(MFC PLA1)		
	7. A to B	7. 43 to 117 OHMS	
	8. C to D	8. 53 to 131 OHMS	
	9. C to E	9. 53 to 131 OHMS	
	10. A to C	10. GT 100,000 OHMS	
	11. A to GND	11. GT 100,000 OHMS	
	12. C to GND	12. GT 100,000 OHMS	

Table 1. System Fault Code 4200: Resolver Circuit A (continued)

Step	Procedure	Result	Corrective Action
1.e. (cont.)	CONN J101 PINS		e.1.b. (Checks 13 through 30) Replace AFC cable.
	(AFC CMV)		
	13. A to B	13. 43 to 117 OHMS	
	14. C to D	14. 53 to 131 OHMS	
	15. C to E	15. 53 to 131 OHMS	
	16. A to C	16. GT 100,000 OHMS	
	17. A to GND	17. GT 100,000 OHMS	
	18. C to GND	18. GT 100,000 OHMS	
	CONN J103 PINS		
	(AFC DMV)		
	19. A to B	19. 43 to 117 OHMS	
	20. C to D	20. 53 to 131 OHMS	
	21. C to E	21. 53 to 131 OHMS	
	22. A to C	22. GT 100,000 OHMS	
	23. A to GND	23. GT 100,000 OHMS	
	24. C to GND	24. GT 100,000 OHMS	
	CONN J99 PINS		
	(AFC SSV)		
	25. A to B	25. 43 to 117 OHMS	
	26. C to D	26. 53 to 131 OHMS	
	27. C to E	27. 53 to 131 OHMS	
	28. A to C	28. GT 100,000 OHMS	
	29. A to GND	29. GT 100,000 OHMS	
	30. C to GND	30. GT 100,000 OHMS	
	CONN J93 PINS		e.1.c. (Checks 31 through 42) Replace AFC cable.
	(CIVV)		
	31. A to B	31. 43 to 117 OHMS	
	32. C to D	32. 53 to 131 OHMS	
	33. C to E	33. 53 to 131 OHMS	
	34. A to C	34. GT 100,000 OHMS	
	35. A to GND	35. GT 100,000 OHMS	
	36. C to GND	36. GT 100,000 OHMS	

Table 1. System Fault Code 4200: Resolver Circuit A (continued)

Step	Procedure	Result	Corrective Action
1.e. (cont.)	CONN J89 PINS (LH RCVV) 37. A to B 38. C to D 39. C to E 40. A to C 41. A to GND 42. C to GND	37. 43 to 117 OHMS 38. 53 to 131 OHMS 39. 53 to 131 OHMS 40. GT 100,000 OHMS 41. GT 100,000 OHMS 42. GT 100,000 OHMS e.2. Resistance checks out of limits.	e.2. Replace following resolvers as required by above resistance checks: Checks — Component/Module 1 to 12 — MFC 13 to 30 — AFC 31 to 36 — CIVV control and cylinder 37 to 42 — LH RCVV actuator

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform snap acceleration/deceleration check. Check for System Fault Code 4200. Replace components in following order until engine operates properly: • DEEC • AFC • CIVV control and cylinder • LH RCVV actuator • MFC • Actuator cable • MFC cable • AFC cable	a. System Fault Code 4200 does not repeat. b. System Fault Code 4200 repeats.	a. Return engine to service. b. Replace next component and repeat steps 2 and 3.

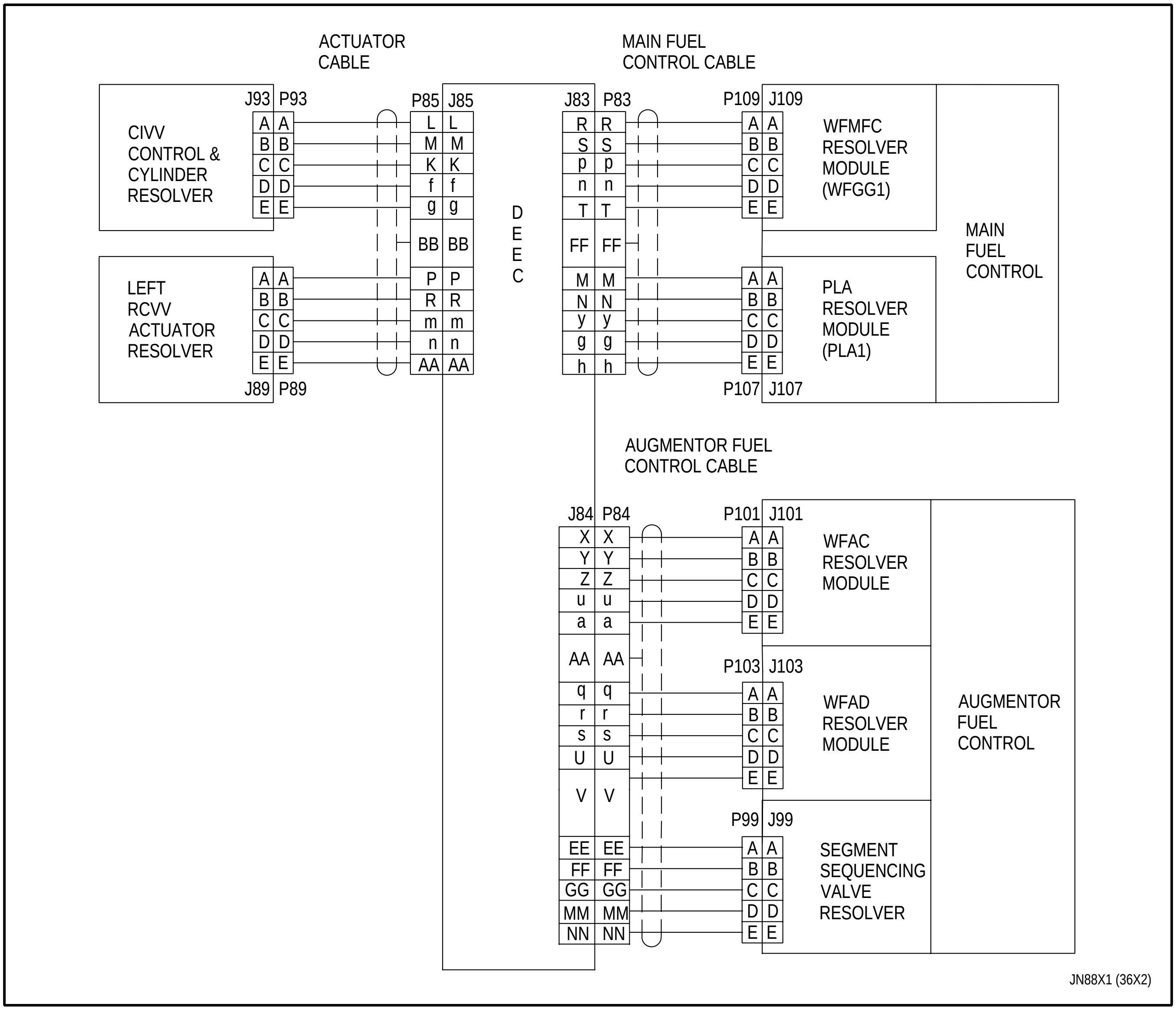


Figure 1. Resolver Circuit A (Sheet 1 of 2)

CIVV RESOLVER RESISTANCE LIMITS		
PINS (P85)	PINS (J93)	OHMS
L-M	A-B	43-117
K-f	C-D	53-131
K-g	C-E	53-131
L-K	A-C	GT 100,000
L-GND	A-GND	GT 100,000
K-GND	C-GND	GT 100,000
L-BB		GT 100,000
K-BB		GT 100,000
RCVV1 RESOLVER RESISTANCE LIMITS		
PINS (P85)	PINS (J89)	OHMS
P-R	A-B	43-117
m-n	C-D	53-131
m-AA	C-E	53-131
P-m	A-C	GT 100,000
P-GND	A-GND	GT 100,000
m-GND	C-GND	GT 100,000
P-BB		GT 100,000
n-BB		GT 100,000
WFMFC RESOLVER RESISTANCE LIMITS		
PINS (P83)	PINS (J109)	OHMS
R-S	A-B	43-117
p-n	C-D	53-131
p-T	C-E	53-131
R-p	A-C	GT 100,000
R-GND	A-GND	GT 100,000
p-GND	C-GND	GT 100,000
R-FF		GT 100,000
p-FF		GT 100,000
PLA1 RESOLVER RESISTANCE LIMITS		
PINS (P83)	PINS (J107)	OHMS
M-N	A-B	43-117
y-g	C-D	53-131
y-h	C-E	53-131
M-y	A-C	GT 100,000
M-GND	A-GND	GT 100,000
y-GND	C-GND	GT 100,000
M-FF		GT 100,000
y-FF		GT 100,000

WFAC RESOLVER RESISTANCE LIMITS		
PINS (P84)	PINS (J101)	OHMS
X-Y	A-B	43-117
Z-u	C-D	53-131
Z-a	C-E	53-131
X-Z	A-C	GT 100,000
X-GND	A-GND	GT 100,000
Z-GND	C-GND	GT 100,000
X-AA		GT 100,000
Z-AA		GT 100,000
WFAD RESOLVER RESISTANCE LIMITS		
PINS (P84)	PINS (J103)	OHMS
q-r	A-B	43-117
s-U	C-D	53-131
s-V	C-E	53-131
q-s	A-C	GT 100,000
q-GND	A-GND	GT 100,000
s-GND	C-GND	GT 100,000
q-AA		GT 100,000
s-AA		GT 100,000
SEGMENT SEQUENCING VALVE RESOLVER RESISTANCE LIMITS		
PINS (P84)	PINS (J99)	OHMS
EE-FF	A-B	43-117
GG-MM	C-D	53-131
GG-NN	C-E	53-131
EE-GG	A-C	GT 100,000
EE-GND	A-GND	GT 100,000
GG-GND	C-GND	GT 100,000
EE-AA		GT 100,000
GG-AA		GT 100,000

JN87X2 (44X2)

Figure 1. Resolver Circuit A (Sheet 2 of 2)

3. SYSTEM FAULT CODE 4201: RESOLVER CIRCUIT B.
(See Figure 2 and Table 2.)

a. Cause of Fault:

(1) Excitation voltage to CENC, MFC MV No. 2, MFC RCVV No. 2, and MFC PLA No. 2 resolvers fails range check due to malfunctioning DEEC power supply or short-loading power supply.

b. Engine Symptoms:

(1) ENP closed

(2) Exhaust nozzle area trim inhibited

(3) Augmentation inhibited

(4) Transfer to Secondary Mode if System Fault Code 4200 also present

c. Test Cell Observations (System Fault Code 4201 only):

(1) AUGMENTOR MN light on

(2) ENGINE CAUTION light on

(3) SYSTEM FAULT light on

(4) EDU Event Code 1220: Augmentor inhibit

d. Additional Test Cell Observations (System Fault Codes 4201 and 4200 present):

(1) SECONDARY CAUTION light on

(2) EDU Event Code 1200: Auto transfer to Secondary Mode

Table 2. System Fault Code 4201: Resolver Circuit B

Step	Procedure	Result	Corrective Action
1.	Perform the following resistance checks (See figure 2):		
	a. CONN P83 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	1. P to FF 2. AA to FF 3. f to FF 4. w to FF	1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace MFC cable.
	b. CONN P85 PINS	b.1. Resistance checks within limits:	b.1. Go to c.
	1. N to BB 2. h to BB 3. S to BB 4. T to BB	1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Replace actuator cable.
	c. CONN P83 PINS	c.1. Resistance checks within limits:	c.1. Go to step 2.
	(MFC MV2) 1. P to k 2. AA to m 3. AA to z 4. P to AA 5. P to GND 6. AA to GND	 1. 43 to 117 OHMS 2. 53 to 131 OHMS 3. 53 to 131 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS 6. GT 100,000 OHMS	
	(PLA2) 7. f to L 8. w to x 9. w to e 10. f to w 11. f to GND 12. w to GND	 7. 43 to 117 OHMS 8. 53 to 131 OHMS 9. 53 to 131 OHMS 10. GT 100,000 OHMS 11. GT 100,000 OHMS 12. GT 100,000 OHMS	
	CONN P85 PINS		
	(CENC) 13. N to k 14. h to y 15. h to z 16. N to h 17. N to GND 18. h to GND	 13. 43 to 117 OHMS 14. 53 to 131 OHMS 15. 53 to 131 OHMS 16. GT 100,000 OHMS 17. GT 100,000 OHMS 18. GT 100,000 OHMS	

Table 2. System Fault Code 4201: Resolver Circuit B (continued)

Step	Procedure	Result	Corrective Action
1.c. (cont.)	CONN P85 PINS (RH RCVV)		
	19. S to A	19. 43 to 117 OHMS	
	20. T to U	20. 53 to 131 OHMS	
	21. T to p	21. 53 to 131 OHMS	
	22. S to T	22. GT 100,000 OHMS	
	23. S to GND	23. GT 100,000 OHMS	
	24. T to GND	24. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Perform resistance checks in d. only for those components found out of limits in c. Disconnect following connectors as required. Component/Module — CONN MFC MV resolver — P109 MFC PLA resolver — P107 — P91 CENV resolver — P90 RH RCVV actuator
	d. CONN J109 PINS	d.1. Resistance checks within limits:	d.1.a. (Checks 1 through 12) Replace MFC cable.
	(MFC MV2)		
	1. F to G	1. 43 to 117 OHMS	
	2. H to J	2. 53 to 131 OHMS	
	3. H to K	3. 53 to 131 OHMS	
	4. F to H	4. GT 100,000 OHMS	
	5. G to BND	5. GT 100,000 OHMS	
	6. H to GND	6. GT 100,000 OHMS	
	CONN J107 PINS (PLA2)		
	7. F to G	7. 43 to 117 OHMS	
	8. H to J	8. 53 to 131 OHMS	
	9. H to K	9. 53 to 131 OHMS	
	10. F to H	10. GT 100,000 OHMS	
	11. F to GND	11. GT 100,000 OHMS	
	12. H to GND	12. GT 100,000 OHMS	

Table 2. System Fault Code 4201:
Resolver Circuit B (continued)

Step	Procedure	Result	Corrective Action
1.d. (cont.)	CONN J91 PINS		d.1.b. (Checks 13 through 24) Replace actuator cable.
	(CENC)		
	13. A to B	13. 43 to 117 OHMS	
	14. C to D	14. 53 to 131 OHMS	
	15. C to E	15. 53 to 131 OHMS	
	16. A to C	16. GT 100,000 OHMS	
	17. A to GND	17. GT 100,000 OHMS	
	18. C to GND	18. GT 100,000 OHMS	
	CONN J90 PINS		
	(RH RCVV)		
	19. A to B	19. 43 to 117 OHMS	
	20. C to D	20. 53 to 131 OHMS	
	21. C to E	21. 53 to 131 OHMS	
	22. A to C	22. GT 100,000 OHMS	
	23. A to GND	23. GT 100,000 OHMS	
	24. C to GND	24. GT 100,000 OHMS	
		d.2. Resistance checks out of limits.	d.2. Replace following resolvers as required by above resistance checks: Checks — Component/Module 1 to 12 — MFC 13 to 18 — CENC 19 to 24 — RH RCVV actuator

Table 2. System Fault Code 4201: Resolver Circuit B (continued)

Step	Procedure	Result	Corrective Action
NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.			
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform IDLE functional check. Check for System Fault Code 4201. Replace following components in order until engine operates properly:	a. System Fault Code 4201 does not repeat.	a. Return engine to service.
	• DEEC • CENC • RH RCVV actuator • MFC • MFC cable • Actuator cable	b. System Fault Code 4201 repeats.	b. Replace next component and repeat steps 2 and 3.

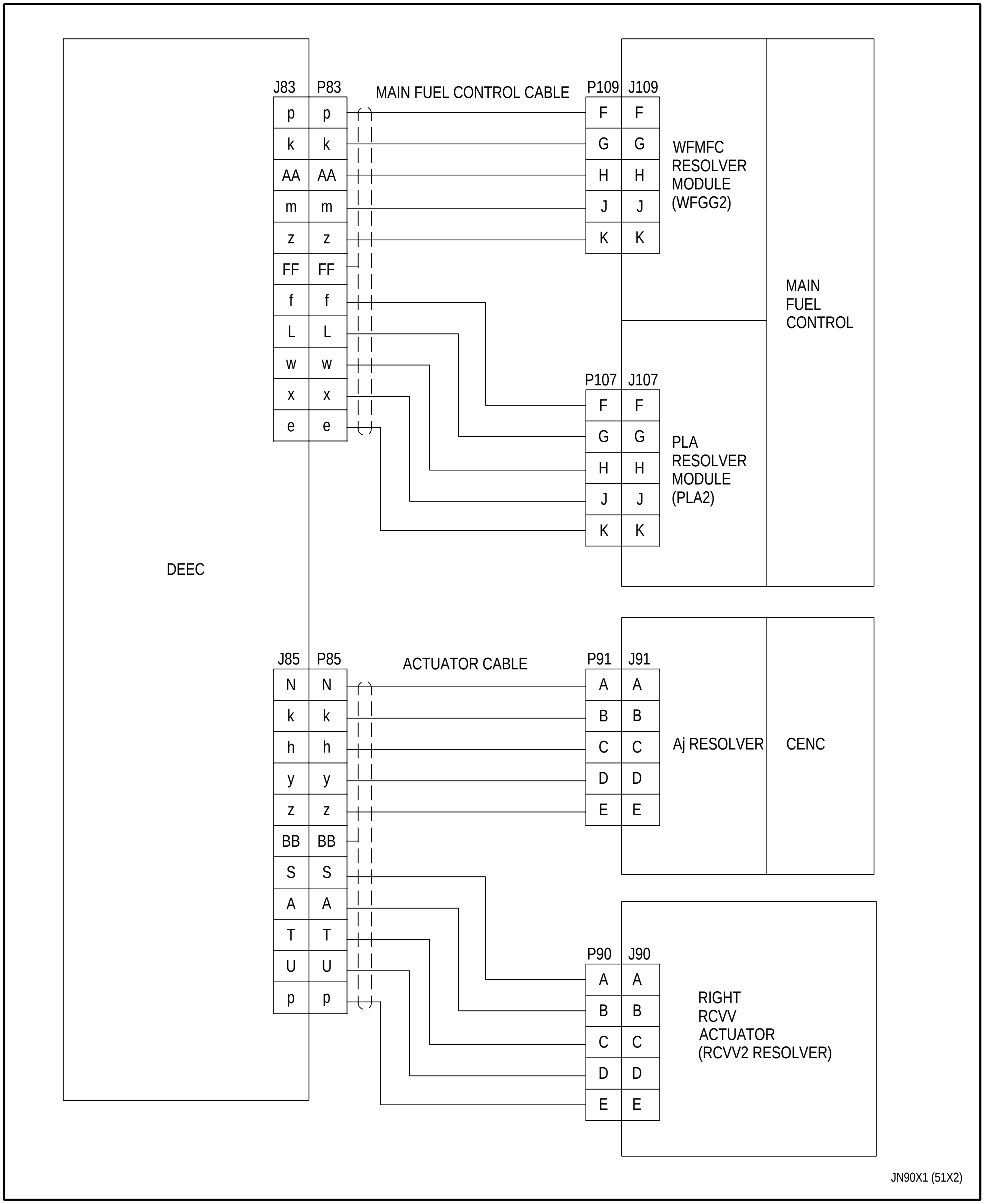


Figure 2. Resolver Circuit B (Sheet 1 of 2)

WFMFC RESOLVER RESISTANCE LIMITS		
PINS (P83)	PINS (J109)	OHMS
P-k	F-G	43-117
AA-m	H-J	53-131
AA-z	H-K	53-131
P-AA	F-H	GT 100,000
P-GND	G-GND	GT 100,000
AA-GND	H-GND	GT 100,000
P-FF		GT 100,000
AA-FF		GT 100,000

PLA2 RESOLVER RESISTANCE LIMITS		
PINS (P83)	PINS (J107)	OHMS
f-L	F-G	43-117
w-x	H-J	53-131
w-e	H-K	53-131
f-w	F-H	GT 100,000
f-GND	F-GND	GT 100,000
w-GND	H-GND	GT 100,000
f-FF		GT 100,000
w-FF		GT 100,000

Aj RESOLVER RESISTANCE LIMITS		
PINS (P85)	PINS (J91)	OHMS
N-k	A-B	43-117
h-y	C-D	53-131
h-z	C-E	53-131
N-h	A-C	GT 100,000
N-GND	A-GND	GT 100,000
h-GND	C-GND	GT 100,000
N-BB		GT 100,000
h-BB		GT 100,000

RCVV2 RESOLVER RESISTANCE LIMITS		
PINS (P85)	PINS (J90)	OHMS
S-A	A-B	43-117
T-U	C-D	53-131
T-p	C-E	53-131
S-T	A-C	GT 100,000
S-GND	A-GND	GT 100,000
T-GND	C-GND	GT 100,000
S-BB		GT 100,000
T-BB		GT 100,000

JN89X1 (24X2)

Figure 2. Resolver Circuit B (Sheet 2 of 2)

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4210: EDU/DEEC COMMUNICATION (UART)

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	18				
3 - 4	13				
5	17				
6 - 8	13				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Primary Mode Engine Start	WP 210 00
Idle Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
System Fault Code 4170 DEEC Power Supply	WP 619 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	SYSTEM FAULT CODE 4210: EDU/DEEC COMMUNICATION (UART)	
	OHMMETER	PSM-6 OR EQUIVALENT

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for Universal Asynchronous Receiver/ Transmitter(UART) system.

b. DEEC provides digital fault flag and operating/scheduling data to EDU through UART circuit.

2. SYSTEM FAULT CODE 4210: EDU/DEEC COMMUNICATION (UART).

(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) EDU stops receiving UART data from DEEC for 10 seconds or 10 separate times.

(2) DEEC power supply interruption/malfunction

b. Engine Symptoms:

(1) None, if malfunction in UART data transmission from DEEC or EDU.

(2) Transfer to Secondary Mode, if power to DEEC is lost or interrupted or if DEEC failure causing auto-transfer also prevents UART transmission.

c. Test Cell Observations:

(1) SYSTEM FAULT light on.

(2) SECONDARY CAUTION light on if DEEC power is lost or interrupted or DEEC failure causing auto-transfer also prevents UART transmission.

(3) ENGINE CAUTION light on if transmission interruption (fault) detected due to UART communication failure or out of range code.

Table 1. System Fault Code 4210: EDU/DEEC Communication (UART)

Step	Procedure	Result	Corrective Action
1.	Perform General Troubleshooting procedures per WP 501 00.		Go to step 2.
2.	Determine if Primary mode malfunction or auto-SEC transfer occurred with fault code 4210.	a. Primary mode malfunction or auto-SEC transfer occured.	a. Go to step 9.
		b Primary mode malfunction or auto-SEC transfer did not occur.	b Go to step 4.
		c. Fault code 4210 occured during SEC mode operation.	c. Go to step 3.
3.	Perform Primary mode engine start per WP 210 00.	a. Engine starts in Primary mode.	a Go to step 4.
		b. Engine remains in SEC mode.	b. Go to step 9.
4.	Remove connectors as follows: P82 from DEEC, P121 from EDU, P77 from J77, and P1 test stand connector from J1. Perform following resistance checks (See figure 1):		
	CONN P82 PINS 1. MM to p 2. NN to p 3. MM to NN 4. MM to GND 5. NN to GND	a. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS 5. GT 100,000 OHMS	a. Install P1 from test stand and P77 from support equipment. Go to step 5.
		b. Resistance checks out of limits.	b. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 6.

Table 1. System Fault Code 4210: EDU/DEEC Communication (UART)

Step	Procedure	Result	Corrective Action
5.	Perform following continuity checks (See figure 1): CONN P82 to CONN P121 PINS 1. MM to L 2. NN to M	a. Continuity checks within limits: 1. LT 5 OHMS 2. LT 5 OHMS	a. Install P82 connector on DEEC and P121 connector on EDU. Go to step 6.
		b. Continuity checks out of limits.	b. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 6.

NOTE

Data not cleared from EDU may be mis-interpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
6.	Check that EDU data has been read and saved per WP 651 00; then clear EDU data per WP 656 00.		Go to step 7.

NOTE

Advisory code 5170 (EDU/DEEC communication interruption) present during EDU data review in step 7 indicates UART anomaly still exists.

Step	Procedure	Result	Corrective Action
7.	Perform idle functional test per WP 216 00. Review EDU data for system fault code 4210 or 5170 per WP 651 00.	a. System fault codes 4210 or 5170 do not repeat.	a. Return engine to service.
		b. System fault code 4210 or 5170 repeat.	b. Replace components in following order: Refer to T.O. 2J-F100-53-4, • DEEC WP 007 00. • EDU WP 023 00. • Power and speed cable WP 019 00. Go to step 8.

Table 1. System Fault Code 4210: EDU/DEEC Communication (UART) (continued)

Step	Procedure	Result	Corrective Action
8.	Clear EDU data per WP 656 00 and return to step 7.		
9.	Perform system fault code 4170 DEEC power supply procedures per WP 619 00.	a. No discrepancies noted. b. Discrepancies noted.	a. Go to step 10. b. Perform corrective action as directed in 4170 fault code procedures. Go to step 10.

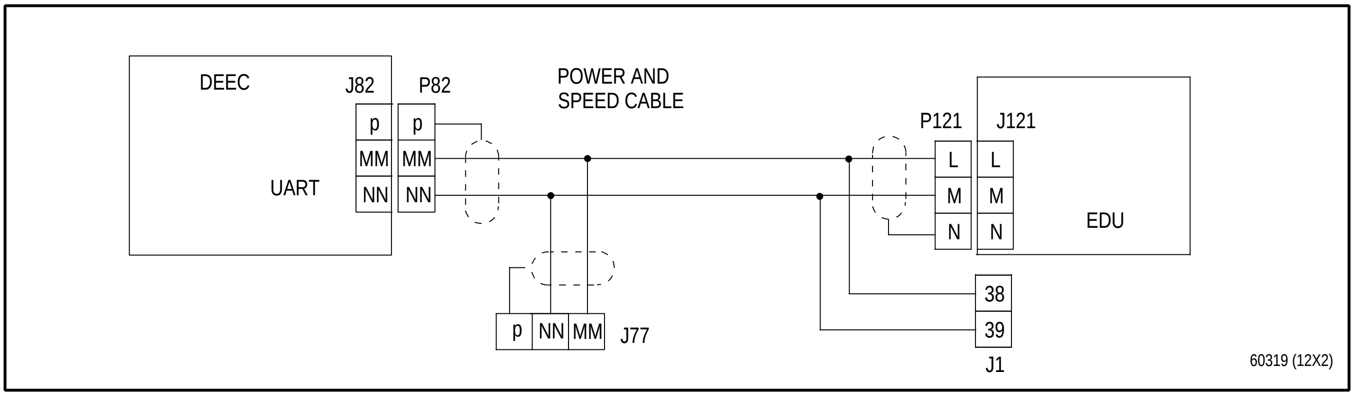
NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
10.	Check that EDU data has been read and saved per WP 651 00; then clear EDU data per WP 656 00.		

Table 1. System Fault Code 4210: EDU/DEEC Communication (UART) (continued)

Step	Procedure	Result	Corrective Action
11.	Perform IDLE functional test per WP 216 00. Review EDU data for system fault code per WP 651 00.	a. System Fault Code 4210 does not repeat. b. System Fault Code 4210 repeats.	a. Return engine to service. b. Replace components in following order: Refer to T.O. 2J-F100-53-4, • DEEC WP 007 00. • Power and speed cable WP 019 00. • MFC Mode solenoid and screen assembly WP 009 00. • Compressor bleed solenoid WP 009 00. • Anti-ice valve WP 039 00. • Augmentor ignition relay assembly WP 010 00. • Actuator cable WP 019 00. • Gas generator control cable WP 019 00. • AFC cable WP 019 00. • Generator stator WP 021 00. • Generator rotor WP 022 00. Go to step 12.
12.	Clear EDU data per WP 656 00 and return to step 11.		



CONNECTOR	PINS	OHMS
P82	MM to p	GT 100,000
	NN to p	GT 100,000
	MM to NN	GT 100,000
	MM to GND	GT 100,000
	NN to GND	GT 100,000
P82 to P121	MM to L	LT 5
	NN to M	LT 5

Figure 1. DEEC/EDU UART Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4220: MOP SIGNAL OUT OF RANGE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	28	5 - 6	28	7	0
2 - 4	0			8	28

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4220: MOP Signal Out of Range	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for main oil pressure (MOP) signal out of range.

2. SYSTEM FAULT CODE 4220: MOP SIGNAL OUT OF RANGE.

(See Figure 1 and Table 1.)

a. Cause of Fault:

NOTE

The MOP signal is also provided to test cell.

(1) Main oil pressure signal to EDU from main oil pressure transmitter (MOPT) out of –0.5 to 110 psia range

(2) Malfunction detected in MOPT.

b. Engine Symptoms:

(1) None

c. Test Cell Observations:

(1) Erroneous MOP reading

(2) SYSTEM FAULT light on

Table 1. System Fault Code 4220: MOP Signal Out Of Range

Step	Procedure	Result	Corrective Action
1.	Check test cell MOP and ENP instruments for proper operation.	a. Instruments operate properly.	a. Go to step 2.
		b. Instruments do not operate properly.	b. Troubleshoot test cell instruments.
2.	Disconnect J2 from EDU. Check test cell power supply to MOPT (See Figure 1):		
	CONN P2, PINS 29 to 30	a. Voltage check within limits: 23 to 29 VAC.	a. Go to step 2.
		b. Voltage check out of limits.	b. Troubleshoot test cell power supply and cables.
3.	Check MOPT circuit. Perform following resistance checks (See figure 1):		
	a. CONN P51, PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	1. 14 to 15	1. GT 100,000 OHMS	
	2. 14 to 16	2. GT 100,000 OHMS	
	3. 17 to 18	3. GT 100,000 OHMS	
	4. 17 to 19	4. GT 100,000 OHMS	
	5. 17 to 20	5. GT 100,000 OHMS	
	6. 22 to 23	6. GT 100,000 OHMS	
	7. 22 to 24	7. GT 100,000 OHMS	
	8. 25 to 29	8. GT 100,000 OHMS	
	9. 26 to 29	9. GT 100,000 OHMS	
	10. 27 to 29	10. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace accessories cable.

Table 1. System Fault Code 4220: MOP Signal Out Of Range (continued)

Step	Procedure	Result	Corrective Action
3. (cont'd)	b. CONN P51 PINS 1. 23 to 24 2. 25 to 26 3. 25 to 27 4. 26 to 27 5. 28 to GND 6. 23 to GND 7. 25 to GND	b.1. Resistance checks within limits: 1. LT 18 OHMS 2. LT 8 OHMS 3. LT 8 OHMS 4. LT 8 OHMS 5. LT 8 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS	b.1. Go to step 4.
		b.2. Resistance checks out of limits.	b.2. Disconnect P8 from MOPT. Go to c.
	c. CONN J8 PINS 1. A to B 2. C to D 3. C to E 4. D to E 5. F to GND 6. A to GND 7. C to GND	c.1. Resistance checks within limits: 1. LT 18 OHMS 2. LT 8 OHMS 3. LT 8 OHMS 4. LT 8 OHMS 5. LT 8 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS	c.1. Replace accessories cable.
		c.2. Resistance checks out of limits.	c.2. Replace MOPT.
4.	If ENP values out of limits, check ENPT circuit. Perform following resistance checks (See Figure 1):		
	a. CONN P51 PINS 1. 15 to 16 2. 18 to 19 3. 18 to 20 4. 19 to 20 5. 21 to GND 6. 15 to GND 7. 18 to GND	a.1. Resistance checks within limits: 1. LT 18 OHMS 2. LT 8 OHMS 3. LT 8 OHMS 4. LT 8 OHMS 5. LT 8 OHMS 6. GT 100,000 OHMS 7.GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Disconnect P7 from CENC ENPT. Go to b.

Table 1. System Fault Code 4220: MOP Signal Out Of Range (continued)

Step	Procedure	Result	Corrective Action
4. (cont'd)	b. CONN J7 PINS 1. C to F 2. A to B 3. A to D 4. B to D 5. E to GND 6. C to GND 7. A to GND	b.1. Resistance checks within limits: 1. LT 18 OHMS 2. LT 8 OHMS 3. LT 8 OHMS 4. LT 8 OHMS 5. LT 8 OHMS 6. GT 100,000 OHMS 7. GT 100,000 OHMS	b.1. Go to step 4.
		b.2. Resistance checks out of limits.	b.2. Replace ENPT.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
5.	Check that EDU data has been reviewed and stored		
6.	Perform IDLE Function check. Check for System Fault Code 4220. Replace following components in order until engine operates properly:	a. System Fault Code 4220 does not repeat.	a. Return engine to service.
	• ENPT • MOPT • EDU • Accesssories	b. System Fault Code 4220 repeats.	b. Replace next component and repeat steps 5. and 6.

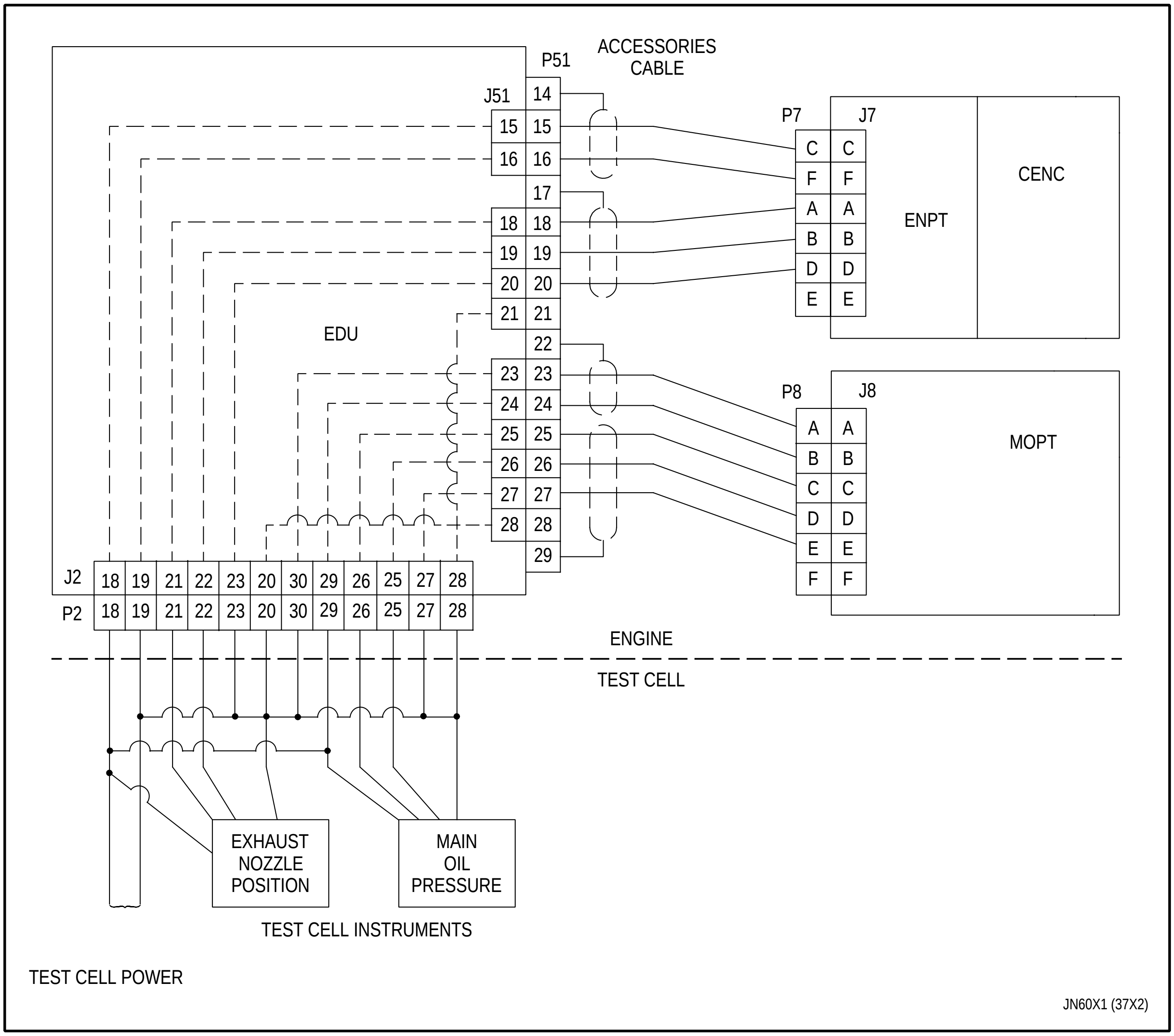


Figure 1. Exhaust Nozzle Position Transmitter (ENPT) and Main Oil Pressure Transmitter (MOPT) Circuit (Sheet 1 of 2)

MOPT RESISTANCE LIMITS		
PINS (P51)	PINS (J8)	OHMS
23–24	A–B	LT 18
25–26	C–D	LT 8
25–27	C–E	LT 8
26–27	D–E	LT 8
28–GND	F–GND	LT 8
23–GND	A–GND	GT 100,000
25–GND	C–GND	GT 100,000
22–23		GT 100,000
22–24		GT 100,000
25–29		GT 100,000
26–29		GT 100,000
27–29		GT 100,000
ENPT RESISTANCE LIMITS		
PINS (P51)	PINS (J7)	OHMS
15–16	C–F	LT 18
18–19	A–B	LT 8
18–20	A–D	LT 8
19–20	B–D	LT 8
21–GND	E–GND	LT 8
15–GND	C–GND	GT 100,000
18–GND	A–GND	GT 100,000
14–15		GT 100,000
14–16		GT 100,000
17–18		GT 100,000
17–19		GT 100,000
17–20		GT 100,000

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Figure 1. Exhaust Nozzle Position Transmitter (ENPT) and Main Oil Pressure Transmitter (MOPT) Circuit (Sheet 2 of 2)

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4230 - 4240; MFC AND AFC EHV SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 18

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 17	0	18 Blank	0		

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Acceleration/Deceleration Check Procedures	WP 210 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4230: AFC Core and Duct Metering Valve EHV Circuit	
	Ohmmeter	PSM-6 or equivalent
3	System Fault Code 4231: EHV Current Error (Sum of AFC, CIVV, CENC EHV)	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package provides description and troubleshooting procedures of the AFC core and duct metering valve EHV system. This applies to fault codes associated with DC current management to and from the DEEC and torque-motor malfunction.

b. Hardware Description:

(1) Electro-hydraulic servo valves (EHV's) for augmentor core fuel flow (WFAC) (segments 1 through 8), and augmentor duct fuel flow (WFAD) (segments 9 through 11) are located on the augmentor fuel control (AFC).

c. System Operation:

(1) EHV's convert electrical signals from the DEEC into hydraulic-pressure signals for actuator/metering valves positioning.

(2) Each EHV has parallel redundant coils for armature torquing. Current created in the DEEC splits and travels to each EHV coil, individually.

(3) Loss of current to a single coil disables torquing action on one side of the armature but doubles the action from the other, maintaining proper EHV operation.

d. Fault Detection:

(1) Wires from each AFC metering valve (core and duct) EHV coil are grouped together in the DEEC. Wires from one side of each AFC metering valve EHV combine to form group A. The others form group B.

(2) The DEEC monitors the return currents. If the difference between groups A and B exceeds fixed limits, a torque-motor fault (4230) for the AFC core and duct metering valves EHV's in the system is recorded.

e. Fault Identification:

(1) Return wires from the three AFC core and duct metering valve EHV coils are grouped together, and as a result, the DEEC cannot identify a single malfunctioning AFC EHV. Troubleshooting shall be performed on each AFC EHV of the system.

(2) Malfunctions in the AFC metering valves EHV's (WFAC and WFAD) are indicated by a 4230 fault code.

2. SYSTEM FAULT CODE 4230: AFC CORE AND DUCT METERING VALVE EHV CIRCUIT. (See Figure 1 and Table 1.)

a. Cause of Fault:

(1) Augmentor core fuel flow (WFAC) and augmentor duct fuel flow (WFAD) servo valve return currents disagree during redundant windings check.

b. Engine Symptoms:

NOTE

Failure of one of the two AFC electro-hydraulic servo valve (EHV) winding circuits (A and B) may trip fault flag (4230) with no effect on engine operation.

(1) None

c. Test Cell Observation:

(1) SYSTEM FAULT light on

Table 1. System Fault Code 4230:
AFC Core and Duct Metering Valve EHV Circuit

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks (See figure 1):		
	a. CONN P84 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	1. b to AA	1. GT 100,000 OHMS	
	2. c to AA	2. GT 100,000 OHMS	
	3. e to AA	3. GT 100,000 OHMS	
	4. f to AA	4. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace AFC cable.
	b. CONN P84 PINS	b.1. Resistance checks within limits:	b.1. Go to step 2.
	(AFC CMV)		
	1. b to A	1. 106 to 214 OHMS	
	2. c to B	2. 106 to 214 OHMS	
	3. b to c	3. GT 100,000 OHMS	
	4. b to GND	4. GT 100,000 OHMS	
	5. c to GND	5. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Disconnect P100 connector from AFC EHV modules as required. Go to c.6.
	(AFC DMV)		
	6. e to D	6. 106 to 214 OHMS	
	7. f to E	7. 106 to 214 OHMS	
	8. e to f	8. GT 100,000 OHMS	
	9. e to GND	9. GT 100,000 OHMS	
	10. f to GND	10. GT 100,000 OHMS	
		b.3. Resistance checks out of limits.	b.3. Disconnect P102 connector from AFC EHV modules as required. Go to c.1.

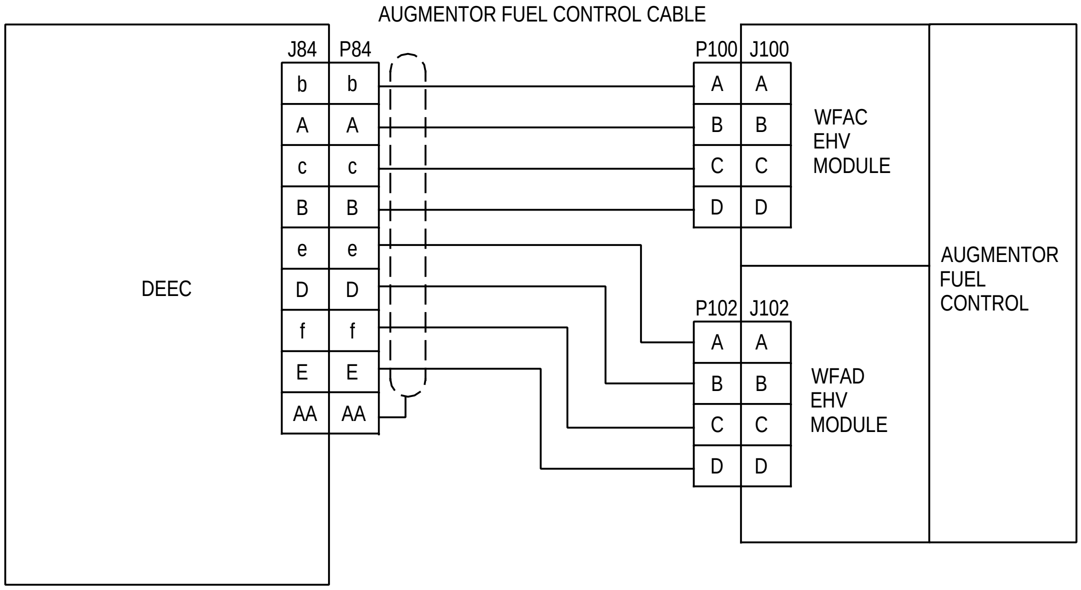
**Table 1. System Fault Code 4230:
AFC Core and Duct Metering Valve EHV Circuit (continued)**

Step	Procedure	Result	Corrective Action
1. (cont'd)	c. CONN J102 PINS (AFC CMV)	c.1. Resistance checks within limits:	c.1. Replace AFC cable.
	1. A to B	1. 106 to 214 OHMS	
	2. C to D	2. 106 to 214 OHMS	
	3. A to C	3. GT 100,000 OHMS	
	4. A to GND	4. GT 100,000 OHMS	
	5. C to GND	5. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Replace AFC duct metering valve EHV module.
	CONN J100 PINS (AFC DMV)		
	6. A to B	6. 106 to 214 OHMS	
	7. C to D	7. 106 to 214 OHMS	
	8. A to C	8. GT 100,000 OHMS	
	9. A to GND	9. GT 100,000 OHMS	
	10. C to GND	10. GT 100,000 OHMS	
		c.3. Resistance checks out of limits.	c.3. Replace AFC core metering valve EHV module.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform acceleration/ deceleration functional check. Check for System Fault Code 4230. Replace components in following order until engine operates properly:	a. System Fault Code 4230 does not repeat.	a. Return engine to service
	• AFC cable • AFC core metering valve EHV • AFC duct metering valve EHV • DEEC	b. System Fault Code 4230 repeats.	b. Replace next component and repeat steps 2 and 3.



WFAC EHV RESISTANCE LIMITS		
PINS (P84)	PINS (J102)	OHMS
b–A	A–B	106–214
c–B	C–D	106–214
b–c	A–C	GT 100,000
b–GND	A–GND	GT 100,000
c–GND	C–GND	GT 100,000
b–AA		GT 100,000
c–AA		GT 100,000
WFAD EHV RESISTANCE LIMITS		
PINS (P84)	PINS (J100)	OHMS
e–D	A–B	106–214
f–E	C–D	106–214
e–f	A–C	GT 100,000
e–GND	A–GND	GT 100,000
f–GND	C–GND	GT 100,000
e–AA		GT 100,000
f–AA		GT 100,000

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Figure 1. WFAC and WFAD EHV Circuits

3. SYSTEM FAULT CODE 4231: EHV CURRENT ERROR (SUM OF AFC, CIVV, CENC EHV).
(See Figure 2 and Table 2.)

a. Cause of Fault:

(1) Sum of returning currents from AFC, CIVV, and CENC EHV does not equal currents requested by DEEC.

b. Engine Symptom:

(1) None

c. Test Cell Observation:

(1) SYSTEM FAULT light on

Table 2. SYSTEM FAULT Code 4231: EHV Current Error (Sum of AFC, CIVV, CENC EHV)

Step	Procedure	Result	Corrective Action
1.	Perform the following resistance checks (See figure 2):		
	a. CONN P85 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	1. HH to BB	1. GT 100,000 OHMS	
	2. Y to BB	2. GT 100,000 OHMS	
	3. v to BB	3. GT 100,000 OHMS	
	4. u to BB	4. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace actuator cable.
	b. CONN P85 PINS	b.1. Resistance checks within limits:	b.1. Go to step 2.
	1. HH to EE	1. 113 to 227 OHMS	
	2. Y to s	2. 113 to 227 OHMS	
	3. HH to y	3. GT 100,000 OHMS	
	4. HH to GND	4. GT 100,000 OHMS	
	5. Y to GND	5. GT 100,000 OHMS	
		b.1.a. Resistance checks out of limits.	b.1.a. Go to c.
		b.2. Resistance checks within limits:	b.2. Go to step 2.

**Table 2. System Fault Code 4231:
EHV Current Error (Sum of AFC, CIVV, CENC EHV) (continued)**

Step	Procedure	Result	Corrective Action
1. (cont'd)	6. v to c	6. 113 to 227 OHMS	
	7. u to DD	7. 113 to 227 OHMS	
	8. v to u	8. GT 100,000 OHMS	
	9. v to GND	9. GT 100,000 OHMS	
	10. u to GND	10. GT 100,000 OHMS	
		b.2.a. Resistance checks out of limits.	b.2.a. Go to d.
	c. CONN J92 PINS	c.1. Resistance checks within limits:	c.1. Replace actuator cable.
	1. A to B	1. 113 to 227 OHMS	
	2. C to D	2. 113 to 227 OHMS	
	3. A to C	3. GT 100,000 OHMS	
	4. A to GND	4. GT 100,000 OHMS	
	5. C to GND	5. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Replace CENC EHV.
	d. CONN J94 PINS	d.1. Resistance checks within limits:	d.1. Replace actuator cable.
	1. A to B	1. 113 to 227 OHMS	
	2. C to D	2. 113 to 227 OHMS	
	3. A to C	3. GT 100,000 OHMS	
	4. A to GND	4. GT 100,000 OHMS	
	5. C to GND	5. GT 100,000 OHMS	
		d.2. Resistance checks out of limits.	d.2. Replace CIVV EHV.
2.	Perform following resistance checks (See figure 2):		
	a. CONN P84 PINS	a.1 Resistance checks within limits:	a.1. Go to b.
	1. b to AA	1. GT 100,000 OHMS	
	2. c to AA	2. GT 100,000 OHMS	
	3. e to AA	3. GT 100,000 OHMS	
	4. f to AA	4. GT 100,000 OHMS	
	5. v to AA	5. GT 100,000 OHMS	
	6. x to AA	6. GT 100,000 OHMS	

**Table 2. System Fault Code 4231:
EHV Current Error (Sum of AFC, CIVV, CENC EHV) (continued)**

Step	Procedure	Result	Corrective Action
2. (cont'd)		a.2. Resistance checks out of limits.	a.2. Replace AFC cable.
	b. CONN P84 PINS	b.1. Resistance checks within limits:	b.1. Go to step 3.
	1. v to w	1. 113 to 227 OHMS	
	2. x to y	2. 113 to 227 OHMS	
	3. v to x	3. GT 100,000 OHMS	
	4. v to GND	4. GT 100,000 OHMS	
	5. x to GND	5. GT 100,000 OHMS	
		b.1.a. Resistance checks out of limits.	b.1.a. Go to c.
		b.2. Resistance checks within limits:	b.2. Go to step 3.
	6. b to A	6. 113 to 227 OHMS	
	7. c to B	7. 113 to 227 OHMS	
	8. b to c	8. GT 100,000 OHMS	
	9. b to GND	9. GT 100,000 OHMS	
	10. c to GND	10. GT 100,000 OHMS	
		b.2.a. Resistance checks out of limits.	b.2.a. Go to d.
		b.3. Resistance checks within limits:	b.3. Go to step 3.
	11. e to D	11. 113 to 227 OHMS	
	12. f to E	12. 113 to 227 OHMS	
	13. e to f	13. GT 100,000 OHMS	
	14. e to GND	14. GT 100,000 OHMS	
	15. f to GND	15. GT 100,000 OHMS	
		b.3.a. Resistance checks out of limits.	b.3.a. Go to e.
	c. CONN J98 PINS	c.1. Resistance checks within limits:	c.1. Replace AFC cable.
	1. A to B	1. 113 to 227 OHMS	
	2. C to D	2. 113 to 227 OHMS	
	3. A to C	3. GT 100,000 OHMS	
	4. A to GND	4. GT 100,000 OHMS	
	5. C to GND	5. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Replace AFC segment sequencing valve EHV module.

Table 2. System Fault Code 4231:
EHV Current Error (Sum of AFC, CIVV, CENC EHV) (continued)

Step	Procedure	Result	Corrective Action
2. (cont'd)	d. CONN J100 PINS	d.1. Resistance checks within limits:	d.1. Replace AFC cable.
	1. A to B	1. 113 to 227 OHMS	
	2. C to D	2. 113 to 227 OHMS	
	3. A to C	3. GT 100,000 OHMS	
	4. A to GND	4. GT 100,000 OHMS	
	5. C to GND	5. GT 100,000 OHMS	
		d.2. Resistance checks out of limits.	d.2. Replace AFC core metering valve EHV module.
	e. CONN J102 PINS	e.1. Resistance checks within limits:	e.1. Replace AFC cable.
	1. A to B	1. 113 to 227 OHMS	
	2. C to D	2. 113 to 227 OHMS	
	3. A to C	3. GT 100,000 OHMS	
	4. A to GND	4. GT 100,000 OHMS	
	5. C to GND	5. GT 100,000 OHMS	
		e.2. Resistance checks out of limits.	e.2. Replace AFC duct metering valve EHV module.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored; then clear EDU data.		
4.	Perform Primary Mode functional check. Check for System Fault Code 4231. Replace components in following order until engine operates properly: • CIVV EHV • AFC duct EHV • AFC core EHV • DEEC • AFC sequencing EHV • Actuator cable • AFC cable	a. System Fault Code 4231 does not repeat.	a. Return engine to service.
		b. System Fault Code 4231 repeats.	b. Replace next component. Repeat steps 3 and 4.

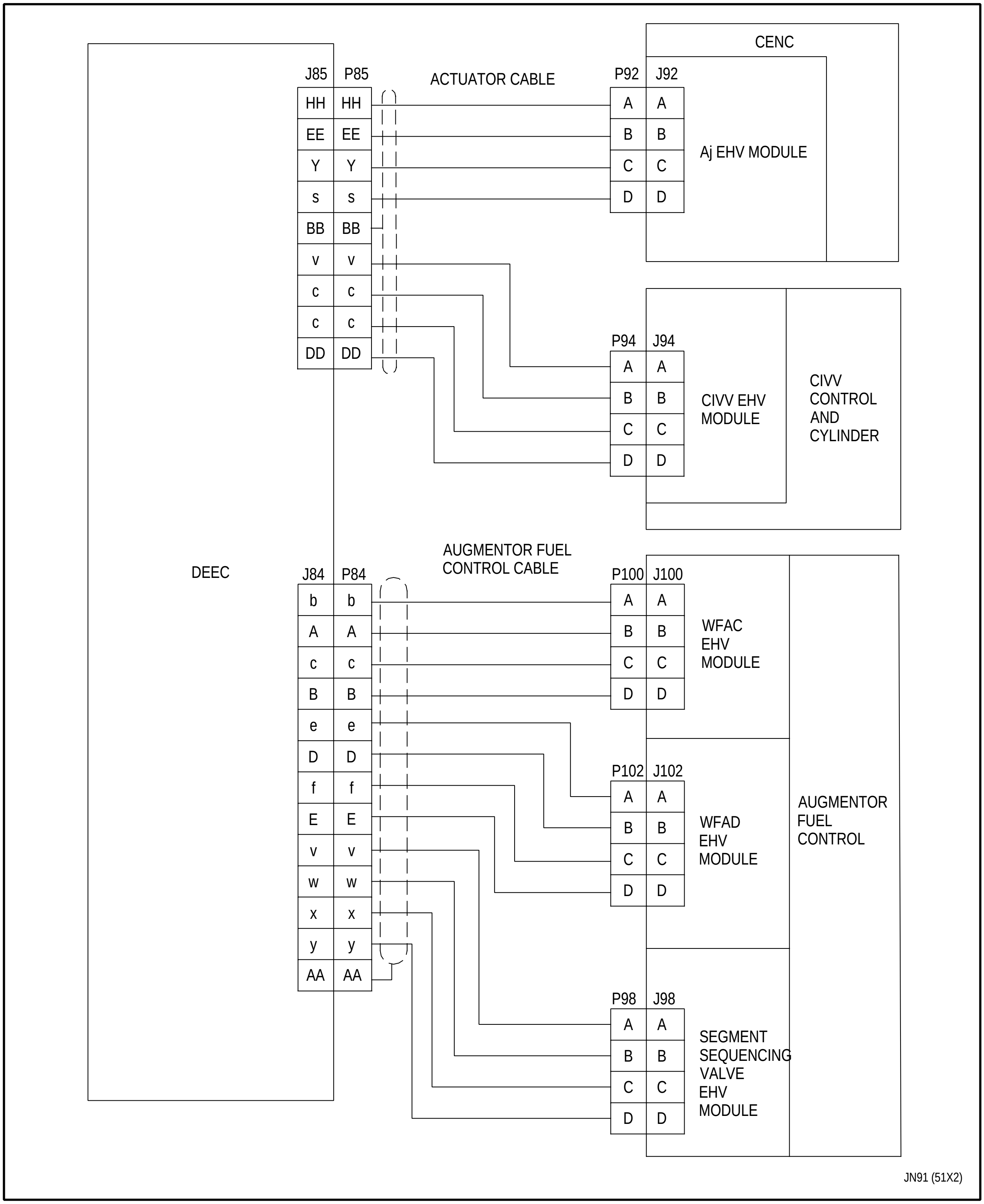


Figure 2. EHV Current Error (Sum of AFC, CIVV, CENC EHV) (Sheet 1 of 2)

Aj EHV RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P85	HH–EE	113–227
	Y–s	113–227
	HH–Y	GT 100,000
	HH–GND	GT 100,000
	Y–GND	GT 100,000
	HH–BB	GT 100,000
	Y–BB	GT 100,000
CIVV EHV RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P85	v–c	113–227
	u–DD	113–227
	v–u	GT 100,000
	v–GND	GT 100,000
	u–GND	GT 100,000
	y–BB	GT 100,000
	u–BB	GT 100,000

Aj EHV RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P92	A–B	113–227
	C–D	113–227
	A–C	GT 100,000
	A–GND	GT 100,000
	C–GND	GT 100,000
CIVV EHV RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P94	A–B	113–227
	C–D	113–227
	A–C	GT 100,000
	A–GND	GT 100,000
	C–GND	GT 100,000

WFAC EHV RESISTANCE LIMITS		
PINS (P84)	PINS (J100)	OHMS
b–A	A–B	113–227
c–B	C–D	113–227
b–c	A–C	GT 100,000
b–GND	A–GND	GT 100,000
c–GND	C–GND	GT 100,000
b–AA		GT 100,000
c–AA		GT 100,000
WFAD EHV RESISTANCE LIMITS		
PINS (P84)	PINS (J102)	OHMS
e–D	A–B	113–227
f–E	C–D	113–227
e–f	A–C	GT 100,000
e–GND	A–GND	GT 100,000
f–GND	C–GND	GT 100,000
e–AA		GT 100,000
f–AA		GT 100,000
SEGMENT SEQUENCING VALVE EHV RESISTANCE LIMITS		
PINS (P84)	PINS (J98)	OHMS
v–w	A–B	113–227
x–y	C–D	113–227
v–x	A–C	GT 100,000
v–GND	A–GND	GT 100,000
x–GND	C–GND	GT 100,000
v–AA		GT 100,000
x–AA		GT 100,000

JN92 (51X2)

**Figure 2. EHV Current Error (Sum of AFC, CIVV, CENC EHV)
(Sheet 2 of 2)**

4. SYSTEM FAULT CODE 4240: EHV CURRENT ERROR (SUM OF WFMFC AND RCVV EHV).

(See Figure 3, and Table 3.)

a. Cause of Fault.

(1) Sum of currents returning from WFMFC and RCVV EHV does not match currents requested by DEEC.

b. Engine Symptom:

(1) DEEC accommodates fault

c. Test Cell Observation:

(1) SYSTEM FAULT light on

Table 3. System Fault Code 4240: EHV Current Error (Sum of WFMFC and RCVV EHV)

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks (See figure 3):		
	a. CONN P83 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	1. B to FF	1. GT 100,000 OHMS	
	2. q to FF	2. GT 100,000 OHMS	
	3. CC to FF	3. GT 100,000 OHMS	
	4. Z to FF	4. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace MFC cable.
	b. CONN P83 PINDS	b.1. Resistance checks within limits:	b.1. Go to step 2.
	(MFC WFMFC)		
	1. B to A	1. 113 to 227 OHMS	
	2. q to U	2. 113 to 227 OHMS	
	3. B to q	3. GT 100,000 OHMS	
	4. B to GND	4. GT 100,000 OHMS	
	5. q to GND	5. GT 100,000 OHMS	
		b.1.a. Resistance checks out of limits.	b.1.a Go to c.
		b.2. Resistance checks within limits.	b.2. Go to step 2.
	(MFC RCVV)		
	6. CC to s	6. 113 to 227 OHMS	
	7. Z to F	7. 113 to 227 OHMS	
	8. CC to Z	8. GT 100,000 OHMS	
	9. CC to GND	9. GT 100,000 OHMS	
	10. Z to GND	10. GT 100,000 OHMS	
		b.2.a Resistance checks out of limits.	b.2.a. Go to d.
	c. CONN J108 PINS	c.1. Resistance checks within limits:	c.1. Replace MFC cable.
	(MFC WFMFC)		
	1. A to B	1. 112 to 227 OHMS	
	2. C to D	2. 113 to 227 OHMS	
	3. A to C	3. GT 100,000 OHMS	
	4. A to GND	4. GT 100,000 OHMS	
	5. C to GND	5. GT 100,000 OHMS	

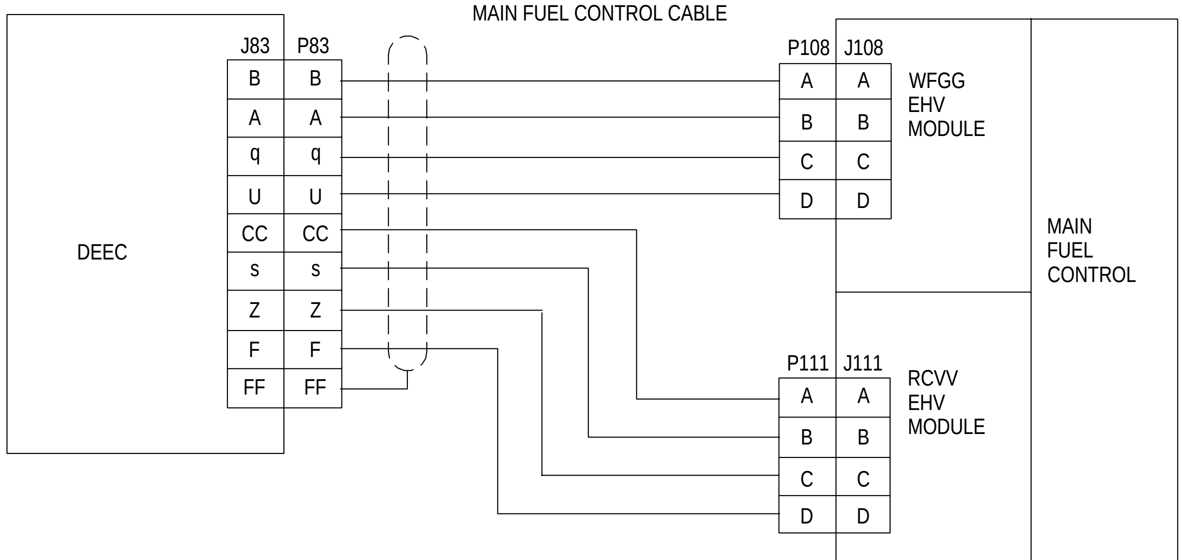
**Table 3. System Fault Code 4240:
EHV Current Error (Sum of WFMFC and RCVV EHV) (continued)**

Step	Procedure	Result	Corrective Action
1. (cont'd)		c.2. Resistance checks out of limits.	c.2. Replace MFC WFMFC EHV module.
	d. CONN J111 PINS (MFC RCVV)	d.1. Resistance checks within limits:	d.1. Replace MFC cable.
	1. A to B	1. 113 to 227 OHMS	
	2. C to D	2. 113 to 227 OHMS	
	3. A to C	3. GT 100,000 OHMS	
	4. A to GND	4. GT 100,000 OHMS	
	5. C to GND	5. GT 100,000 OHMS	
		d.2 Resistance checks out of limits.	d.2. Replace MFC RCVV EHV module.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear EDU data.		
3.	Perform Primary Mode functional check. Check for System Fault Code 4240. Replace components in following order until engine operates properly: • MFC metering valve EHV • MFC RCVV EHV • DEEC • MFC cable	a. System Fault Code 4240 does not repeat.	a. Return engine to service.
		b. System Fault Code 4240 repeats.	b. Replace next component. Repeat steps 2 and 3.



WFGG EHV RESISTANCE LIMITS		
PINS (P83)	PINS (J108)	OHMS
B–A	A–B	113–227
q–U	C–D	113–227
B–q	A–C	GT 100,000
B–GND	A–GND	GT 100,000
q–GND	C–GND	GT 100,000
B–FF		GT 100,000
q–FF		GT 100,000

RCVV EHV RESISTANCE LIMITS		
PINS (P83)	PINS (J111)	OHMS
CC–s	A–B	113–227
Z–F	C–D	113–227
CC–Z	A–C	GT 100,000
CC–GND	A–GND	GT 100,000
Z–GND	C–GND	GT 100,000
CC–FF		GT 100,000
Z–FF		GT 100,000

JN75 (37X2)

Figure 3. WFMFC and RCVV EHV Circuits

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4250 - 4252: ANTI-ICE SYSTEM

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE SWP PAGES

Total Number of Pages in this SWP is 16

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	27	10 - 12	9	14	9
2 - 8	9	13	27	15	27
9	27			16	9

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 561 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Valve - Anti-icing, Engine Inlet	WP 039 00
Compressive Engine Diagnostic System	T.O. 33D4-6-746-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4250: Anti-ice Thermocouple Out Of Range	
	Volt/Ohmmeter	PSM-6 or equivalent
	Interface cables	PWA 56032 or PWA 56033
	ENGINE Analyzer Unit	PWA 56084
	CEDS Software	PWA 56091
	Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114
3	System Fault Code 4251: Anti-ice Valve Failed Open	
	Volt/Ohmmeter	PSM-6 or equivalent
	Interface cables	PWA 56032 or PWA 56033
	ENGINE Analyzer Unit	PWA 56084
	CEDS Software	PWA 56091
	Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114
4	System Fault Code 4252: Anti-ice Valve Failed Closed	
	Volt/Ohmmeter	PSM-6 or equivalent
	Interface cables	PWA 56032 or PWA 56033
	ENGINE Analyzer Unit	PWA 56084
	CEDS Software	PWA 56091
	Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114

ILLUSTRATED SUPPORT EQUIPMENT

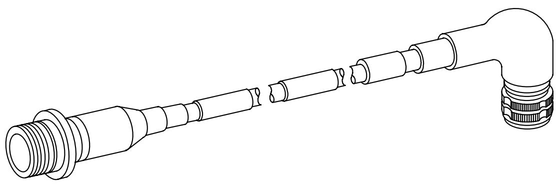


Figure T1. PWA 56032/PWA 56033 Interface Cable (Typical)

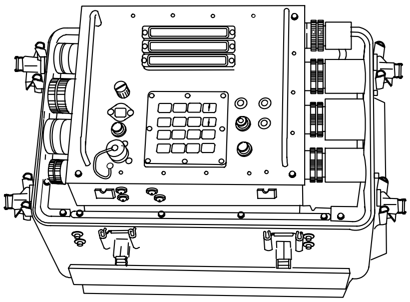


Figure T2. PWA 56084 Engine Analyzer Unit

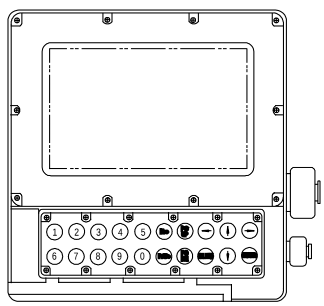


Figure T3. PWA 56102 Transfer Unit

1. INTRODUCTION.

a. This subordinate work package contains troubleshooting procedures for an anti-ice system malfunction.

2. SYSTEM FAULT CODE 4250: ANTI-ICE THERMOCOUPLE OUT OF RANGE.
(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) EDU senses anti-ice thermocouple out of range. When this fault is flagged, the logic for anti-ice overtemp, anti-ice failed open, and anti-ice failed closed is bypassed due to lack of adequate anti-ice temperature input.

b. Engine Symptoms:

(1) None

c. Test Stand Observations:

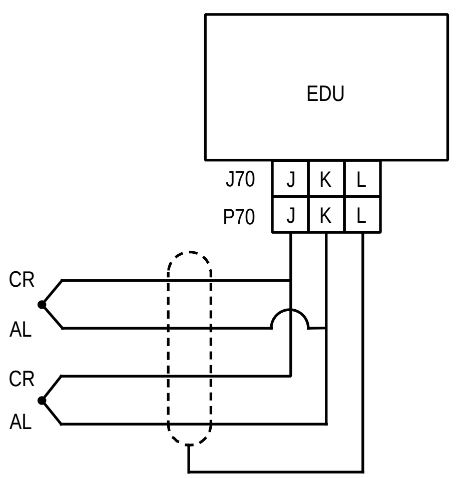
(1) SYSTEM FAULT light ON.

**Table 1. System Fault Code 4250:
Anti-ice Thermocouple Out of Range**

Step	Procedure	Result	Corrective Action
1.	Are any EDU System Fault Codes 3000 to 3999 present?	a. System Fault not present	a. Go to step 2.
		b. System Fault Codes present.	b. Change EDU.
2.	Check EDU connector P70 for looseness or contamination.	a. Connector not loose or contaminated.	a. Go to step 3.
		b. Connector loose or contaminated.	b. Clean connector if required, perform step 3, then tighten connector.
3.	Perform resistance check for anti-ice thermocouple. See figure 1.	a. Resistance checks within limits.	a. Go to step 4.
	CONN P70 / PINS		
	1. J to L 2. J to GND 3. K to GND 4. J to K	1. GT 100,000 OHMS 2. GT 100,000 OHM 3. GT 100,000 OHMS 4. LT 10 OHMS	
		b. Resistance checks out of limits.	b. Change EDU ground access cable.

Table 1. System Fault Code 4250:
Anti-ice Thermocouple Out of Range (continued)

Step	Procedure	Result	Corrective Action
	NOTE Data not cleared from EDU may be misinterpreted as repeating fault or event.		
4.	Ensure EDU data has been reviewed and stored; then clear EDU data.		
5.	Run engine at IDLE. Ensure Idle Area Reset is ON. Check for System Fault Code 4250. Replace components in the following order until engine operates properly:	a. System Fault Code 4250 does not repeat.	a. Return engine to service.
	• EDU ground access cable • EDU	b. System Fault Code 4250 does repeat.	b. Replace next component and repeat steps 4 and 5.



ANTI ICE THERMOCOUPLE – RESISTANCE LIMITS		
CONNECTOR	PINS	OHMS
P70	J – L	GT 100,00 OHMS
	J – GND	GT 100,00 OHMS
	K – GND	GT 100,00 OHMS
	J – K	LT 10 OHMS

5663

Figure 1. Anti-ice Thermocouple - Resistance Limits

3. SYSTEM FAULT CODE 4251: ANTI-ICE VALVE FAILED OPEN.

(See Figure 2 and Table 2.)

a. Cause of Fault:

(1) Anti-ice temperature remains above 399°C (750°F) for 60 seconds after DEEC or test cell request anti-ice OFF

(2) Anti-ice temperature does not decrease 20°C (36°F) within 60 seconds (120 seconds for EDU logic 2.1.2 E/F or later).

(3) Loss of power from DEEC, or test stand

(4) In-range failure of anti-ice thermocouple

(5) Failed anti-ice valve.

b. Engine Symptoms:

(1) Anti-ice overtemp at Intermediate (MIL) power

(2) Closed nozzle, increased FTIT at Intermediate (MIL)

(3) FTIT increase at IDLE

(4) Anti-ice temperature remains high

(5) Possible engine stall or low thrust

c. Test Stand Observations:

(1) SYSTEM FAULT light ON.

(2) ENGINE CATION light ON.

Table 2. System Fault Code 4251: Anti-ice Valve Failed Open

Step	Procedure	Result	Corrective Action
1.	Check following connectors for looseness: 1. P2 (EDU) 2. P51 (EDU) 3. P70 (EDU) 4. P149 (Anti-ice valve) 5. P150 (Anti-ice valve) 6. P85 (DEEC	a. Connectors tight. b. Connectors loose.	a. Go to step 2. b. Clean and reconnect loose connectors. Go to step 5.
2.	Visually inspect anti-ice valve ceramic insulator. Refer to T.O. 2J-F100-53-4, WP 039 00.	a. Insulator passes inspection. b. Insulator fails inspection.	a. Go to step 3. b.Replace anti-ice valve.
3.	Perform following checks of the operator activated anti-ice system. a. CONN P51 PINS 1. 4 to 5 2. 4 to GND 3. 5 to GND b. CONN J149 PINS 1. A to B 2. A to GND 3. B to GND	a.1. Resistance checks within limits. 1. 29 to 51 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS a.2. Resistance checks out of limits. b.1. Resistance checks within limits. 1. 29 to 51 OHMS 2. GT 100,000 OHMS 3. GT 100, 000 OHMS b.2. Resistance checks out of limits.	a.1. Go to step 4. a.2. Go to step b. b.1. Change engine accessories cable. b.2. Change anti-ice valve.
4.	Perform following resistance checks on DEEC-activated anti-ice system.	a.1. Resistance checks within limits.	a.1. Go to step 5.

**Table 2. System Fault Code 4251:
Anti-ice Valve Failed Open (continued)**

Step	Procedure	Result	Corrective Action
4. (cont'd)	a. CONN P85 PINS		
	1. b to H 2. b to GND 3. H to GND	1. 27 to 49 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Go to b.
	b. CONN J150 PINS	b.1. Resistance checks within limits.	b.1. Replace actuator cable.
	1. A to B 2. A to GND 3. B to GND	1. 27 to 49 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Replace anti-ice valve.
5.	a. Perform voltage check as follows:Turn test stand power On. Turn ANTI-ICE switch OFF.	a.1. Voltage within limits with ANTI-ICE switch OFF.	a.1. Go to b.
	CONN P149 PINS		
	A to B	24 to 30 VDC	
		a.2. Voltage out of limits.	a.2. Troubleshoot test stand wiring.
	b. Turn ANTI-ICE switch ON.	b.1. Voltage within limits with ANTI-ICE switch ON.	b.1. Go to step 6.
		O VDC	
		b.2. Voltage out of limits.	b.2. Troubleshoot test stand wiring.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

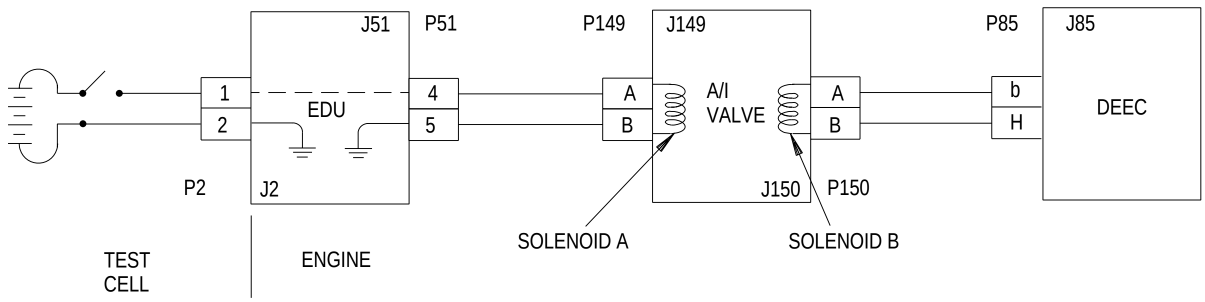
6.	Check that EDU data has been reviewed and stored; then clear EDU data.		

Table 2. System Fault Code 4251: Anti-ice Valve Failed Open (continued)

Step	Procedure	Result	Corrective Action
7.	Visually inspect anti-ice valve flange connections for axial gaps and/or gasket distress (gasket OD edges should be visible). Refer to T.O. 2J-F100-53-4, WP 039 00.	a. Gaps or gasket distress apparent.	a. Repair as required. Check flange bolts and nuts for damage and ensure sufficent run-on torque for assembly.
		b. No gaps or gasket distress.	b. Go to step 8.
8.	Run engine at IDLE. Turn Anti-ice switch ON and check anti-ice manifold and flange connects for air leaks. Turn Anti-ice switch OFF.	a. Leaks found.	a. Repair as required.
		b. No leaks found.	b. Go to step 9.
9.	Run engine at IDLE for 2 minutes. Observe anti-ice temperature (CEDS EDU TAICE,or EAU word 1018). Turn Anti-Ice switch ON and maintain IDLE for 1 minute. Turn Anti-Ice switch OFF. Anti-ice temperature should decrease a minimum of 20°C (36°F) within 2 minutes. Replace components in the following order until engine operates properly: • Anti-ice valve • EDU • Accessories cable	a. Anti-ice valve does not close. b. Anti-ice valve closes.	a. Replace next component and repeat steps 6 and 9. b. Go to step 10.

**Table 2. System Fault Code 4251:
Anti-ice Valve Failed Open (continued)**

Step	Procedure	Result	Corrective Action
	CAUTION Engine operation with anti-ice temperature above 399°C (750°F) may damage inlet case and plumbing.		
10.	Turn Anti-ice switch ON and maintain IDLE for 3 minutes. Increase PLA (CEDS PLAAB,or EAU word 1019) to 60 degrees. Observe anti-ice temperature (CEDS EDU TAICE, or EAU word 1018). Anti-ice temperature should decrease a minimum of 20°C (36°F) within 2 minutes. Replace components in the following order until engine operates properly:	a. Anti-ice valve operates normally.	a. Return engine to service.
	• Anti-ice Valve • DEEC • Actuator Cable	b. Anti-ice valve does not close when PLA is advanced.	b. Replace next component and repeat steps 6, 9 and 10.



ANTI–ICE VALVE SOLENOIDS – RESISTANCE LIMITS		
CONNECTORS	PINS	OHMS
P51	4–5	29–51
	4–GND	GT 100,000
	5–GND	GT 100,000
J149	A–B	29–51
	A–GND	GT 100,000
	B–GND	GT 100,000
P85	b–H	27–49
	b–GND	GT 100,000
	H–GND	GT 100,000
J150	A–B	27–49
	A–GND	GT 100,000
	B–GND	GT 100,000

ANTI–ICE VALVE – VOLTAGE LIMITS				
CONNECTOR	PINS	LIMIT (VDC)	A/I VALVE	A/I SWITCH POS.
P149	A–B	24–30	CLOSED	OFF
	A–B	0	OPEN	ON
P2	1–2	24–30	CLOSED	OFF
	1–2	0	OPEN	ON

OPERATION		
SOLENOID A	SOLENOID B	VALVE POSITION
ENERGIZED	ENERGIZED	CLOSED
ENERGIZED	OFF	CLOSED
OFF	OFF	OPEN
OFF	ENERGIZED	CLOSED

108180 (48X2)

Figure 2. F100-PW-229 Anti-Ice System

4. SYSTEM FAULT CODE 4252: ANTI-ICE VALVE FAILED CLOSED.
(See figure 2 and Table 3.)

a. Cause of Fault:

(1) Anti-ice temperature low for 60 seconds after DEEC or test stand request anti-ice on.

(2) Anti-ice valve malfunction

(3) In-range failure of anti-ice thermocouple

b. Engine Symptoms:

(1) Possible ice accumulation on compressor inlet case when anti-ice request on

c. Test Stand Observations:

(1) SYSTEM FAULT light ON

(2) ENGINE CAUTION light ON

Table 3. System Fault Code 4252: Anti-ice Valve Failed Closed

Step	Procedure	Result	Corrective Action
1.	Check test stand anti-ice power. See to figure 2.		
	a. Listen to solenoid in anti-ice valve when anti-ice switch is cycled ON-OFF-ON.	a.1. Solenoid clicks.	a.1. Go to step 2.
		a.2. Solenoid does not click.	a.2. Go to b.
	b. Perform voltage check as follows:	b.1. Voltage within limits	b.1. Go to step 2.
	CONN PINS A/I SWITCH		
	P149 A to B ON A to B OFF	0 VDC 24 to 30 VDC	
		b.2. Voltage out of limits.	b.2 Go to c.
	c. Check test stand power.	c.1 Voltage within limits.	c.1. Go to d.
	CONN PINS A/I SWITCH		
	P2 1 to 2 OFF 1 to 2 ON	24 to 30 VDC 0 VDC	
		c.2 Voltage out of limits.	c.2. Repair test cell A/I power.

**Table 3. System Fault Code 4252:
Anti-ice Valve Failed Closed (continued)**

Step	Procedure	Result	Corrective Action
1. (cont'd)			
	d. Check engine wiring continuity.	d.1. Continuity checks within limits.	d.1. Replace EDU.
	CONN PIN CONN PIN		
	P149 A P51 4 P149 B P51 5	0 to 5 OHMS 0 to 5 OHMS	
		d.2 Continuity checks out of limits.	d.2. Replace accessory cable.
2.	Visually inspect anti-ice valve flange connections for axial gaps and/or gasket distress (gasket OD edges should be visible). Refer to T.O. 2J-F100-53-4, WP 039 00.	a. Gaps or gasket distress apparent.	a. Repair as required. Check flange bolts and nuts for damage and ensure sufficent run-on torque for assembly.
		b. No gaps or gasket distress.	b. Go to step 2.
3.	Visually inspect anti-ice valve ceramic insulator. Refer to T.O. 2J-F100-53-4, WP 039 00.	a. Insulator passes inspection.	a. Go to step 4.
		b. Insulator does not pass inspection.	b. Replace anti-ice valve.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
4.	Check that EDU data has been reviewed and stored; then clear EDU data.		

**Table 3. System Fault Code 4252:
Anti-ice Valve Failed Closed (continued)**

Step	Procedure	Result	Corrective Action
5.	Run engine at IDLE. Turn Anti-ice switch ON and check anti-ice manifold and flange connects for air leaks. Turn Anti-ice switch OFF.	a. Leaks found.	a. Repair as required.
		b. No leaks found.	b. Go to step 6.
6.	Disconnect P150 from anti-ice valve. Run engine at IDLE for 2 minutes with anti-ice switch OFF. Observe anti-ice temperature (CEDS EDU TAICE or EAU word 1018. Turn anti-ice switch ON.	a. Anti-ice temperature increases at least 20°C.(36°F) within 30 seconds.	a. Go to step 7.
		b. Anti-ice temperature does not increases at least 20°C.(36°F) within 30 seconds.	b. Replace anti-ice valve.
7.	Connect P150 if previously disconnected. Run engine at IDLE for 2 minutes with anti-ice switch OFF. Observe anti-ice temperature (CEDS EDU TAICE or EAU word 1018. Replace components in the following order until engine operates properly: •Anti-ice valve •DEEC •Actuator cable	a. Anti-ice temperature increases at least 20°C.(36°F) within 30 seconds.	a. Return engine to service.
		b. Anti-ice temperature does not increases at least 20°C.(36°F) within 30 seconds.	b. Replace next component and repeat steps 4 and 7.

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4195: IDLE AREA RESET SIGNAL OR GROUND IDLE THRUST SIGNAL FAILURE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	18				
3 - 8	17				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	SYSTEM FAULT CODE 4195: IDLE AREA RESET SIGNAL OR GROUND IDLE THRUST SIGNAL FAILURE	
	OHMMETER	PSM-6 OR EQUIVALENT

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for Idle Area Reset (IAR) or Ground Idle Thrust (GIT) signal.

b. The DEEC checks the IAR and GIT signals to determine if the signals indicate ON or OFF and are compared to Mn value to determine normal operation.

2. SYSTEM FAULT CODE 4195: IDLE AREA RESET SIGNAL OR GROUND IDLE THRUST SIGNAL FAILURE.

(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) GIT discrete signal ON with IAR OFF.

b. Engine Symptoms:

(1) Possible Loss of Idle Area Reset and Ground Idle Thrust scheduling (Flight IDLE speed is scheduled).

c. Test Stand Observations:

(1) SYSTEM FAULT light on.

(2) Possible Loss of Idle Area Reset (Aj less than 10% with PLA at IDLE and test stand IAR switch in reset ON position), and Ground Idle Thrust scheduling (Flight IDLE speed is scheduled).

d. Data Collected:

(1) Fault code(s) and time stamp(s).

**Table 1. System Fault Code 4195:
Idle Area Reset Or Ground Idle Thrust Switch Malfunction**

Step	Procedure	Result	Corrective Action
	NOTE The following test stand operating procedures can cause Fault Code 4195 to be recorded by the engine EMS. • GIT switch ON with IAR switch OFF		
1.	Review operating procedures. Determine if engine was operated with GIT ON and IAR off.	a. Condition occurred.	a. Check that EDU data has been saved. Refer to WP 651 00. Clear EDU, refer to WP 656 00 and return engine to service.
		b. Condition did not occur.	b. Go to step 2.
2.	Perform the following resistance checks. See figure 1. a. CONN P82 PINS 1. v to p 2. b to p	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to step b.
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 4.
	b. CONN P82 PINS IDLE AREA RESET SWITCH - RESET 1. v to b IDLE AREA RESET SWITCH - OFF 2. b to v 3. v to GND 4. b to GND	b.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	b.1. Go to step 3.
		b.2. Resistance checks out of limits.	b.2. Disconnect P1 from J1 connector. Go to step c.

**Table 1. System Fault Code 4195:
Idle Area Reset Or Ground Idle Thrust Switch Malfunction (continued)**

Step	Procedure	Result	Corrective Action
2. (cont'd)	c. CONN P1 PINS	c.1. Resistance checks within limits:	c.1. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 4.
	IDLE AREA RESET SWITCH - RESET		
	1. 10 to 11	1. LT 5 OHMS	
	IDLE AREA RESET SWITCH - OFF		
	2. 11 to 10	2. GT 100,000 OHMS	
	3. 10 to GND	3. GT 100,000 OHMS	
	4. 11 to GND	4. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Repair or replace stand wiring as required. Refer to T.O. 33D4-6-685-1. Go to step 4.
3.	Perform the following resistance checks. See figure 1.		
	a. CONN P82 PINS	a.1. Resistance checks within limits:	a.1. Go to step b.
	1. m to p	1. GT 100,000 OHMS	
	2. j to p	2. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 4.
	b. CONN P82 PINS	b.1. Resistance checks within limits:	b.1. Go to step 4.
	GROUND IDLE THRUST SWITCH - ON		
	1. m to j	1. LT 5 OHMS	
	GROUND IDLE THRUST SWITCH - OFF		
	2. j to m	2. GT 100,000 OHMS	
	3. m to GND	3. GT 100,000 OHMS	
	4. j to GND	4. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Disconnect P1 from J1 connector. Go to step c.

**Table 1. System Fault Code 4195:
Idle Area Reset Or Ground Idle Thrust Switch Malfunction (continued)**

Step	Procedure	Result	Corrective Action
3. (cont'd)	c. CONN PINS P1 GROUND IDLE THRUST SWITCH - ON 1. 16 to 17 GROUND IDLE THRUST SWITCH - OFF 2. 17 to 16 3. 16 to GND 4. 17 to GND	c.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS c.2. Resistance checks out of limits.	c.1. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to Step 4. c.2. Repair or replace stand wiring as required. Refer to T.O. 33D4-6-685-1. Go to Step 4.

NOTE

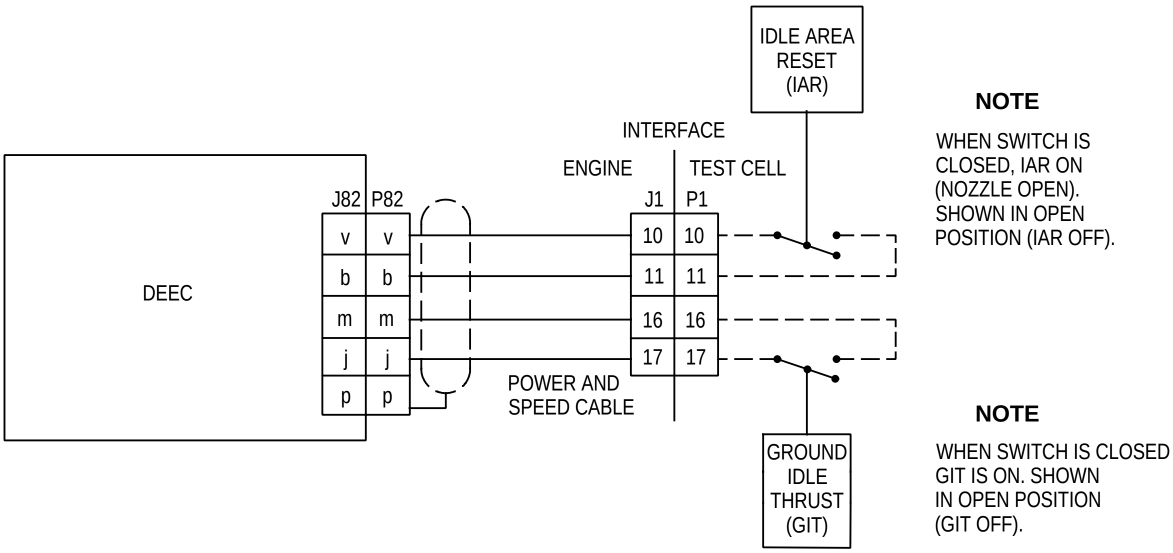
Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
4.	Check that EDU data has been reviewed and stored per WP 651 00; then clear EDU data per WP 656 00.		

**Table 1. System Fault Code 4195:
Idle Area Reset Or Ground Idle Thrust Switch Malfunction (continued)**

Step	Procedure	Result	Corrective Action
5.	Perform IDLE functional check per WP 216 00. Review EDU data for system fault code per WP 651 00.	a. System Fault Code 4195 does not repeat.	a. Return engine to service.
		b. System Fault Code 4195 repeats.	b. Replace components in the following order one at a time and go to Step 6: • Test stand GIT switch. Refer to T.O. 33D4-6-735-1. • Mn simulator (IAR switch). Refer to T.O. 33D4-6-212-41. • DEEC. Refer to T.O. 2J-F100-53-4, WP 007 00. • Power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00.
6.	Clear EDU data per WP 656 00 and return to Step 5.		

Figure 1. IAR and GIT Circuit



IAR SWITCH RESISTANCE LIMITS		
PINS (P82)	PINS (P1)	OHMS
v-b	10-11	LT 5 (ON)
b-v	11-10	GT 100,000 (OFF)
v-GND	10-GND	GT 100,000 (OFF)
b-GND	11-GND	GT 100,000 (OFF)
v-p		GT 100,000 (OFF)
b-p		GT 100,000 (OFF)

GIT SWITCH RESISTANCE LIMITS		
PINS (P82)	PINS (P1)	OHMS
m-j	16-17	LT 5 (ON)
j-m	17-16	GT 100,000 (OFF)
m-GND	16-GND	GT 100,000 (OFF)
j-GND	17-GND	GT 100,000 (OFF)
m-p		GT 100,000 (OFF)
j-p		GT 100,000 (OFF)

JN009056 (44X2)

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4196: REDUNDANT MODE SELECT SIGNALS DISAGREE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4196: Redundant Mode Select Signals Disagree	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

NOTE

Test cell modification kits for F100-PW-229 engines do not have provisions for F16 redundant mode select input. It is unlikely a system fault code 4196 will occur during engine run in the engine test cell.

a. This work package contains troubleshooting procedure for redundant mode select switch malfunction.

b. This fault detection is bypassed for all F15 aircraft.

c. This fault detection is bypassed for F16 aircraft which are not modified for redundant mode select signals.

d. This fault detection is bypassed for all engine test cells.

2. SYSTEM FAULT CODE 4196: REDUNDANT MODE SELECT SIGNALS DISAGREE.

(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) Engine mode select signals from two redundant aircraft mode select switches disagree with each other.

b. Engine Symptoms:

(1) None.

(2) Unable to transfer from Secondary to Primary Mode.

(3) Engine stuck in Secondary Mode after Primary Mode engine start.

c. Test Cell Observations:

(1) SYSTEM FAULT light on.

d. Data Collected:

(1) Fault code(s) and time stamp(s)

Table 1. System Fault Code 4196:
Redundant Mode Select Signals Malfunction

Step	Procedure	Result	Corrective Action
1.	Perform following resistance checks. Note position of aircraft ID switch (See figure 1.):		
	a. CONN P82 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	1. F to p	1. GT 100,000 OHMS	
	2. g to p	2. GT 100,000 OHMS	
	3. BB to p	3. GT 100,000 OHMS	
	4. K to p	4. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable.
	b. CONN P82 PINS	b.1. Resistance checks within limits:	b.1. Go to step 2.
	CONTROL MODE SWITCH IN PRIMARY POSITION		
	1. F to g	1. GT 100,000 OHMS	
	2. BB to K	2. GT 100,000 OHMS	
	3. F to GND	3. GT 100,000 OHMS	
	4. g to GND	4. GT 100,000 OHMS	
	5. BB to GND	5. GT 100,000 OHMS	
	6. K to GND	6. GT 100,000 OHMS	
	CONTROL MODE SWITCH IN SEC POSITION		
	7. F to g	7. GT 100,000 OHMS	
	8. BB to K	8. LT 5 OHMS	
	9. F to GND	9. GT 100,000 OHMS	
	10. BB to GND	10. GT 100,000 OHMS	
	11. g to GND	11. GT 100,000 OHMS	
	12. K to GND	12. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Disconnect P1 from J1. Go to c.
	c. CONN P1 PINS	c.1. Resistance checks within limits:	c.1. Replace power and speed cable.
	CONTROL MODE SWITCH IN PRIMARY POSITION		
	1. 19 to 20	1. GT 100,000 OHMS	
	2. 24 to 25	2. GT 100,000 OHMS	
	3. 19 to GND	3. GT 100,000 OHMS	
	4. 20 to GND	4. GT 100,000 OHMS	
	5. 24 to GND	5. GT 100,000 OHMS	
	6. 25 to GND	6. GT 100,000 OHMS	

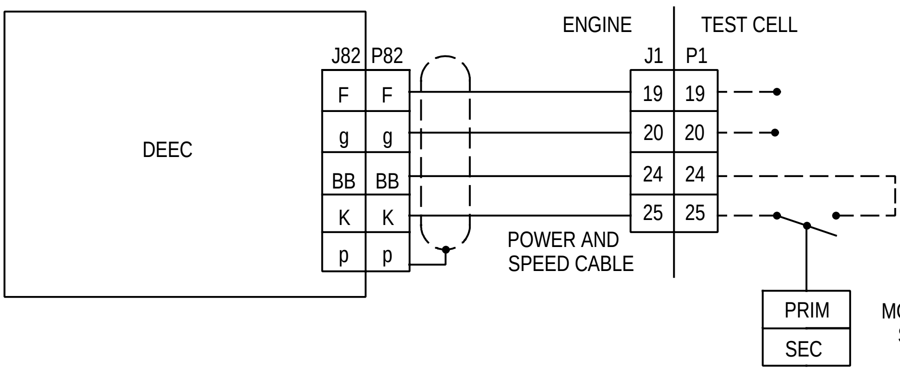
**Table 1. System Fault Code 4196:
Redundant Mode Select Signals Malfunction (continued)**

Step	Procedure	Result	Corrective Action
1. (cont'd)	b CONTROL MODE SWITCH IN SEC POSITION		
	7. 19 to 20	7. GT 100,000 OHMS	
	8. 24 to 25	8. LT 5 OHMS	
	9. 19 to GND	9. GT 100,000 OHMS	
	10. 20 to GND	10. GT 100,000 OHMS	
	11. 24 to GND	11. GT 100,000 OHMS	
	12. 25 to GND	12. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Repair test cell wiring as required.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear data.		
3.	Perform IDLE functional check. Check for System Fault Code 4196. Replace components in following order until engine operates properly:	a. System Fault Code 4196 does not repeat.	a. Return engine to service.
	• Test cell control mode switch • Power and speed cable • DEEC	b. System Fault Code 4196 repeats.	b. Replace next component. Repeat steps 2 and 3.



NOTE

TEST CELL MODIFICATION KITS DO NOT INCLUDE PROVISIONS FOR A SECOND (REDUNDANT) MODE SELECT SWITCH.

NOTE

SWITCH IS SHOWN IN PRIMARY POSITION (SWITCH OPEN).

REDUNDANT MODE SELECT SWITCH RESISTANCE LIMITS		
PINS (P82)	PINS (P1)	OHMS
F - p		GT 100,000
g - p		GT 100,000
BB - p		GT 100,000
K - p		GT 100,000
F - g	19 - 20	GT 100,000(PRIM)
BB - K	24 - 25	GT 100,000(PRIM)
F - g	19 - 20	GT 100,000(SEC)
BB - K	24 - 25	LT 50 (SEC)
F - GND	19	GT 100,000
g - GND	20	GT 100,000
BB - GND	24	GT 100,000
K - GND	25	GT 100,000

JN009057 (44X2)

Figure 1. Redundant Mode Select Switch Circuit Schematic

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4197: F16 AIRCRAFT WIRING MODIFICATION SIGNAL FAILURE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 6	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Idle Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	System Fault Code 4197: F16 Aircraft Wiring Modification Signal Failure	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

NOTE

Test cell modification kits for F100-PW-229 engines do not have provisions for F16 aircraft wiring modification signal. It is unlikely a system fault code 4197 will occur during engine run in the engine test cell.

a. This work package contains troubleshooting procedure for F16 aircraft wiring modification signal.

b. In order for the DEEC to recognize when an F16 has been modified for redundant mode select, the F16 wiring modification will also provide a discrete signal via J-1 connector (J-1, pins 33-34 closed).

2. SYSTEM FAULT CODE 4197: F16 AIRCRAFT WIRING MODIFICATION SIGNAL FAILURE.

(See Figure 1 and Table 1.)

a. Cause of Event:

(1) F16 aircraft’s wiring modification signal has changed compared to signal provided during engine start.

b. Engine Symptoms:

(1) None

c. Test Cell Observations:

(1) SYSTEM FAULT light on

d. Data Collected:

(1) Fault code and time stamp

**Table 1. System Fault Code 4197:
F16 Aircraft Wiring Modification Signal Malfunction**

Step	Procedure	Result	Corrective Action
1.	Perform the following resistance checks. (See figure 1.):		
	a. CONN P82 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	1. JJ to p	1. GT 100,000 OHMS	
	2. KK to p	2. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace engine power and speed cable.
	b. CONN P82 PINS	b.1. Resistance checks within limits:	b.1. Go to step 2.
	1. JJ to KK	1. GT 100,000 OHMS	
	2. JJ to GND	2. GT 100,000 OHMS	
	3. KK to GND	3. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Disconnect P1 from J1 connector. Go to c.
	c. CONN P1 PINS	c.1. Resistance checks within limits:	c.1. Replace engine power and speed cable.
	1. 33 to 34	1. GT 100,000 OHMS	
	2. 33 to GND	2. GT 100,000 OHMS	
	3. 34 to GND	3. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Repair or replace test cell wiring as required.

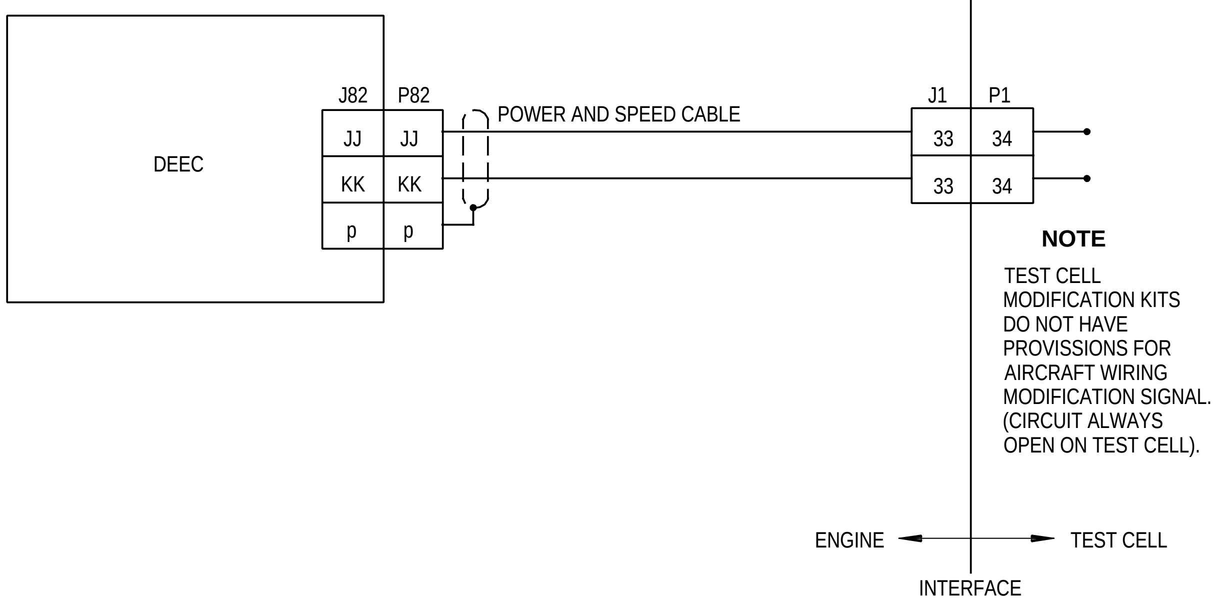
NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
2.	Check that EDU data has been reviewed and stored; then clear data.		

**Table 1. System Fault Code 4197:
F16 Aircraft Wiring Modification Signal Malfunction (continued)**

Step	Procedure	Result	Corrective Action
3.	Perform IDLE functional check. Check for System Fault Code 4197. Replace components in following order until engine operates properly:	a. System Fault Code 4197 does not repeat.	a. Return engine to service.
	• Test stand wiring • Power and speed cable • DEEC	b. System Fault Code 4197 repeats.	b. Replace next component. Repeat steps 2 and 3.



AIRCRAFT WIRING MODIFICATION SIGNAL RESISTANCE LIMITS		
PINS (P82)	PINS (P1)	OHMS
KK-JJ	34-33	GT 100,000
JJ-GND	33-GND	GT 100,000
KK-GND	34-GND	GT 100,000
JJ-p		GT 100,000
JJ-p		GT 100,000

JN009059 (37X2)

Figure 1. Aircraft Wiring Modification Signal Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4198: IDLE AREA RESET SIGNAL MALFUNCTION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	18				
3 - 8	17				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Idle Functional check	WP 216 00
Engine Troubleshooting - General	WP 503 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	SYSTEM FAULT CODE 4198: IDLE AREA RESET SIGNAL MALFUNCTION	
	OHMMETER	PSM-6 OR EQUIVALENT

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for Idle Area Reset (IAR)signal.

b. The DEEC checks the IAR signals to determine if the signals indicate ON or OFF and compares to Mn value to determine normal operation.

2. SYSTEM FAULT CODE 4198: IDLE AREA RESET SIGNAL MALFUNCTION.

(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) IAR ON with Mn greater than 0.7.

b. Engine Symptoms:

(1) Loss of Idle Area Reset, and Ground Idle Thrust cannot be scheduled (Flight IDLE speed is scheduled).

c. Test Stand Observations:

(1) SYSTEM FAULT light on.

(2) Aj less than 10% with PLA at IDLE and test stand IAR switch in reset position, and Ground Idle Thrust cannot be scheduled (Flight IDLE speed is scheduled).

d. Data Collected:

(1) Fault code(s) and time stamp(s).

Table 1. System Fault Code 4198: Idle Area Reset Switch Malfunction

NOTE

- The following test stand operating procedures can cause Fault Code 4198 to be recorded by the engine EMS.
- IAR in reset position with mach number set above 0.7 (321 count)

Step	Procedure	Result	Corrective Action
1.	Review operating procedures. Determine if engine was operated with IAR in reset position and Mn $\geq$ 0.7	a. Condition occurred.	a. Check that EDU data has been saved. Refer to WP 651 00. Clear EDU, refer to WP 656 00 and return engine to service.
		b. Condition did not occur.	b. Go to step 2.
2.	Review EDU data with CEDS per WP 651 00.	a. 4180 fault or 5180 advisory not present.	a. Go to step 3.
		b. 4180 fault or 5180 advisory present.	b. Perform 4180 Mn fault troubleshooting per WP 620 00. Go to step 3 if 4198 repeats.

**Table 1. System Fault Code 4198:
Idle Area Reset Switch Malfunction (continued)**

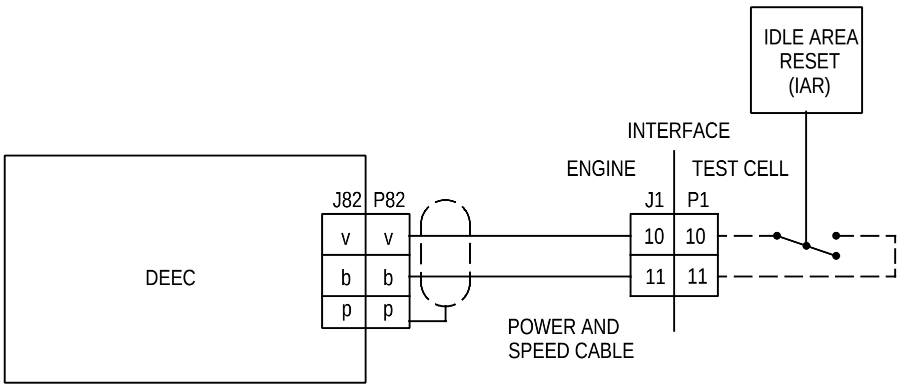
Step	Procedure	Result	Corrective Action
3.	Perform the following resistance checks. See figure 1.		
	a. CONN P82 PINS 1. v to p 2. b to p	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to step b.
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 4.
	b. CONN P82 PINS IDLE AREA RESET SWITCH - RESET 1. v to b IDLE AREA RESET SWITCH - OFF 2. b to v 3. v to GND 4. b to GND	b.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	b.1. Go to step 4.
		b.2. Resistance checks out of limits.	b.2. Disconnect P1 from J1 connector. Go to step c.

Table 1. System Fault Code 4198:
Idle Area Reset Switch Malfunction (continued)

Step	Procedure	Result	Corrective Action
3. (cont'd)	c. CONN PINS P1	c.1. Resistance checks within limits:	c.1. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 4.
	IDLE AREA RESET SWITCH - RESET		
	1. 10 to 11	1. LT 5 OHMS	
	IDLE AREA RESET SWITCH - OFF		
	2. 11 to 10	2. GT 100,000 OHMS	
	3. 10 to GND	3. GT 100,000 OHMS	
	4. 11 to GND	4. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Repair or replace stand wiring as required. Refer to T.O. 33D4-6-685-1. Go to step 4.

Table 1. System Fault Code 4198: Idle Area Reset Switch Malfunction (continued)

Step	Procedure	Result	Corrective Action
NOTE Data not cleared from EDU may be interpreted as repeating fault or event.			
4.	Check that EDU data has been reviewed and stored per WP 651 00; then clear EDU data per WP 656 00. Go to step 5.		
5.	Perform IDLE functional check per WP 216 00. Review EDU data for system fault code per WP 651 00.	a. Fault Code 4198 does not repeat.	a. Return engine to service.
		b. Fault Code 4198 repeats.	b. Replace components in the following order one at a time and go to step 6. • Test Stand IAR switch. Refer to T.O. 33D4-6-685-1. • DEEC. Refer to T.O. 2J-F100-53-4, WP 007 00. • Power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00.
6.	Clear EDU data per WP 656 00 and return to Step 5.		



NOTE

WHEN SWITCH IS CLOSED, IAR ON (NOZZLE OPEN). SHOWN IN OPEN POSITION (IAR OFF).

IAR SWITCH RESISTANCE LIMITS		
PINS (P82)	PINS (P1)	OHMS
v–b	10–11	LT 5 (ON)
b–v	11–10	GT 100,000 (OFF)
v–GND	10–GND	GT 100,000 (OFF)
b–GND	11–GND	GT 100,000 (OFF)
v–p		GT 100,000 (OFF)
b–p		GT 100,000 (OFF)

77765 (36X2)

Figure 1. IAR Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4199: GROUND IDLE THRUST SIGNAL MALFUNCTION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	18				
3 - 8	17				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Idle Functional check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	SYSTEM FAULT CODE 4199: GROUND IDLE THRUST SIGNAL MALFUNCTION	
	OHMMETER	PSM-6 OR EQUIVALENT

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for Ground Idle Thrust (GIT) signal.

b. The DEEC checks GIT signal to determine if the signal indicates ON compared to Mn value to determine normal operation. DEEC checks to see if GIT was stuck off during last flight.

2. SYSTEM FAULT CODE 4199: GROUND IDLE THRUST SIGNAL MALFUNCTION.

(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) GIT discrete signal ON with Mn greater than 0.4 (indicating aircraft is airborne).

or

(2) GIT did not activate (ON) during last flight (GIT remained OFF and IAR cycled) (F-15 only).

b. Engine Symptoms:

(1) None

c. Test Stand Observations:

(1) SYSTEM FAULT light on.

d. Data Collected:

(1) Fault code(s) and time stamp(s).

Table 1. System Fault Code 4199: Ground Idle Thrust Switch Malfunction

Step	Procedure	Result	Corrective Action
NOTE The following test stand operating procedures can cause Fault Code 4199 to be recorded by the engine EMS. • GIT switch ON with Mach Number on Simulator above 0.4 (327 counts)			
1.	Review operating procedures. Determine if engine was operated with GIT ON and Mn ≥ 0.4.	a. Condition occurred.	a. Check that EDU data has been saved. Refer to WP 651 00. Clear EDU, refer to WP 656 00 and return engine to service.
		b. Condition did not occur.	b. Go to step 2.
2.	Review EDU data with CEDS per WP 651 00.	a. 4180 fault or 5180 advisory not present.	a. Go to step 3.
		b. 4180 fault or 5180 advisory present.	b. Perform Mn 4180 troubleshooting per WP 620 00. Go to step 3 if 4199 repeats.

Table 1. System Fault Code 4199: Ground Idle Thrust Switch Malfunction (continued)

Step	Procedure	Result	Corrective Action
3.	Perform the following resistance checks. See figure 1.		
	a. CONN P82 PINS 1. m to p 2. j to p	a.1. Resistance checks within limits: 1. GT 100,000 OHMS 2. GT 100,000 OHMS	a.1. Go to step b.
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 4.
	b. CONN P82 PINS GROUND IDLE THRUST SWITCH - ON 1. m to j GROUND IDLE THRUST SWITCH - OFF 2. j to m 3. m to GND 4. j to GND	b.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS	b.1. Go to step 4.
		b.2. Resistance checks out of limits.	b.2. Disconnect P1 from J1 connector. Go to step c.

Table 1. System Fault Code 4199: Ground Idle Thrust Switch Malfunction (continued)

Step	Procedure	Result	Corrective Action
3. (cont'd)	c. CONN PINS P1 GROUND IDLE THRUST SWITCH - ON 1. 16 to 17 GROUND IDLE THRUST SWITCH - OFF 2. 17 to 16 3. 16 to GND 4. 17 to GND	c.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 100,000 OHMS 3. GT 100,000 OHMS 4. GT 100,000 OHMS c.2. Resistance checks out of limits.	c.1. Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to Step 4. c.2. Repair or replace stand wiring as required. Refer to T.O. 33D4-6-685-1. Go to Step 4.

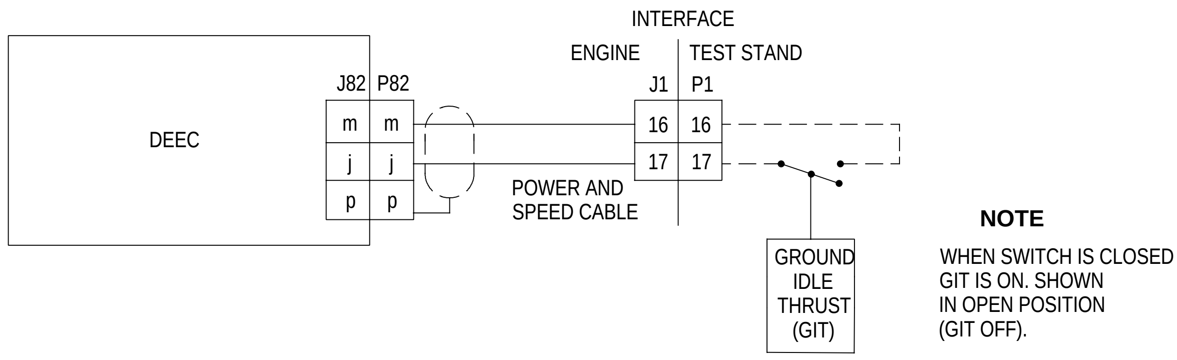
NOTE

Data not cleared from EDU may be interpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
4.	Check that EDU data has been reviewed and stored per WP 651 00; then clear EDU data per WP 656 00. Go to step 5.		

Table 1. System Fault Code 4199:
Ground Idle Thrust Switch Malfunction (continued)

Step	Procedure	Result	Corrective Action
5.	Perform IDLE functional check per WP 216 00. Review EDU per WP 651 00.	a. Fault Code 4199 does not repeat. b. Fault Code 4199 repeats.	a. Return engine to service. b. Replace components in the following order one at a time and go to step 6. • Test stand GIT switch. Refer to T.O. 33D4-6-685-1. • Power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. • DEEC. Refer to T.O. 2J-F100-53-4, WP 007 00.
6.	Clear EDU data per WP 656 00 and return to Step 5.		



GIT SWITCH RESISTANCE LIMITS		
PINS (P82)	PINS (P1)	OHMS
m–j	16–17	LT 5 (ON)
j–m	17–16	GT 100,000 (OFF)
m–GND	16–GND	GT 100,000 (OFF)
j–GND	17–GND	GT 100,000 (OFF)
m–p		GT 100,000 (OFF)
j–p		GT 100,000 (OFF)

74151 (36X2)

Figure 1. GIT Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODES 4330 AND 4331: INTERNAL DEEC/EDU OVERTEMPERATURE

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 7	0	8 Blank	0		

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Idle Functional Check	WP 216 00
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for DEEC and EDU internal overtemperatures.

b. The DEEC and EDU are cooled by fuel independently supplied by the test cell or airframe. Two configurations of fuel cooling are used.

(1) Ejector Cooling: The F-15 C/D models supply a single source of fuel to the DEEC and EDU. An engine mounted ejector valve provides a vacuum to drain fuel from the test cell or airframe fuel tanks. The fuel is then supplied to the fuel pump inlet and combines with the main fuel supply.

(2) Tank Cooling: The F-16 and F-15E models supply fuel to an engine inlet line. This fuel is then circulated and returned to the fuel tank through a separate return line. Normal cooling fuel temperature is approximately 149°F (65°C).

2. SYSTEM FAULT CODE 4330: INTERNAL DEEC OVERTEMPERATURE.

(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) Internal DEEC temperature exceeds 240°F (116°C) for 60 seconds.

b. Engine Symptoms:

(1) None

c. Test Cell Observations:

(1) SYSTEM FAULT light on

Table 1. System Fault Code 4330: Internal DEEC Overtemperature

Step	Procedure	Result	Corrective Action
1.	Review fault and event data.	a. Events or faults. b. No events or faults.	a. Troubleshoot individual event or fault codes. b. Go to step 2.
2.	Check test cell DEEC cooling line and ensure: • Fuel SOV positioned to proper engine configuration: F15C/D Ejector (one quick disconnect; F16 Tank (two quick disconnects; F15E Tank (two quick disconnects) • Fuel cooling line(s) attached to engine. • Fuel being supplied to DEEC/EDU.	a. Fuel cooling supply normal. b. Fuel cooling supply not normal.	a. Go to step 3. b. Repair or replace DEEC fuel cooling supply system as required.

WARNING

Engine bleed air manifolds and tubing are hot. Do not touch these areas while checking for air leaks.

Step	Procedure	Result	Corrective Action
3.	Check 13th stage bleed manifolds and anti-ice connections for leakage.	a. No leakage found. b. Leakage found.	a. Go to step 4. b. Repair as required and go to step 4.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
4.	Check that EDU data has been reviewed and stored; then clear EDU data.		
5.	Perform IDLE functional check with anti-ice on. Check for System Fault Code 4330.	a. System Fault Code 4330 does not repeat. b. System Fault Code 4330 repeats.	a. Return engine to service. b. Replace DEEC and repeat steps 4 and 5.

3. SYSTEM FAULT CODE 4331: INTERNAL EDU OVERTEMPERATURE.
(See figure 1 and Table 2.)

a. Cause of Fault:

(1) Internal EDU temperature exceeds 240°F (116°C) for 60 seconds.

b. Engine Symptoms:

(1) None

c. Test Cell Observations:

(1) SYSTEM FAULT light on

Table 2. System Fault Code 4331: Internal EDU Overtemperature

Step	Procedure	Result	Corrective Action
1.	Review fault and event data.	a. Events or faults.	a. Troubleshoot individual event or fault codes.
		b. No events or faults.	b. Go to step 2.
2.	Check test stand DEEC cooling line and ensure: • Fuel SOV positioned to proper engine configuration: F15 C/D Ejector (one quick disconnect; F16 Tank (two quick disconnects); F15E Tank (two quick disconnects) • Fuel cooling line(s) attached to engine. • Fuel being supplied to DEEC/EDU.	a. Fuel cooling supply normal.	a. Go to step 3.
		b. Fuel cooling supply not normal.	b. Repair or replace DEEC fuel control supply system.

Table 2. System Fault Code 4331: EDU Overtemperature (continued)

Step	Procedure	Result	Corrective Action

WARNING

Engine bleed air manifolds and tubing are hot. Do not touch these areas while checking for air leaks.

Step	Procedure	Result	Corrective Action
3.	Check 13th stage bleed manifolds and anti-ice connections for leakage.	a. No leakage found.	a. Go to step 4.
		b. Leakage found.	b. Repair as required and go to step 4.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
4.	Check that EDU data has been reviewed and stored, then clear EDU data.		
5.	Perform IDLE functional check with anti-ice on. Check for System Fault Code 4331.	a. System Fault Code 4331 does not repeat.	a. Return engine to service.
		b. System Fault Code 4331 repeats.	b. Replace EDU and repeat steps 4 and 5.

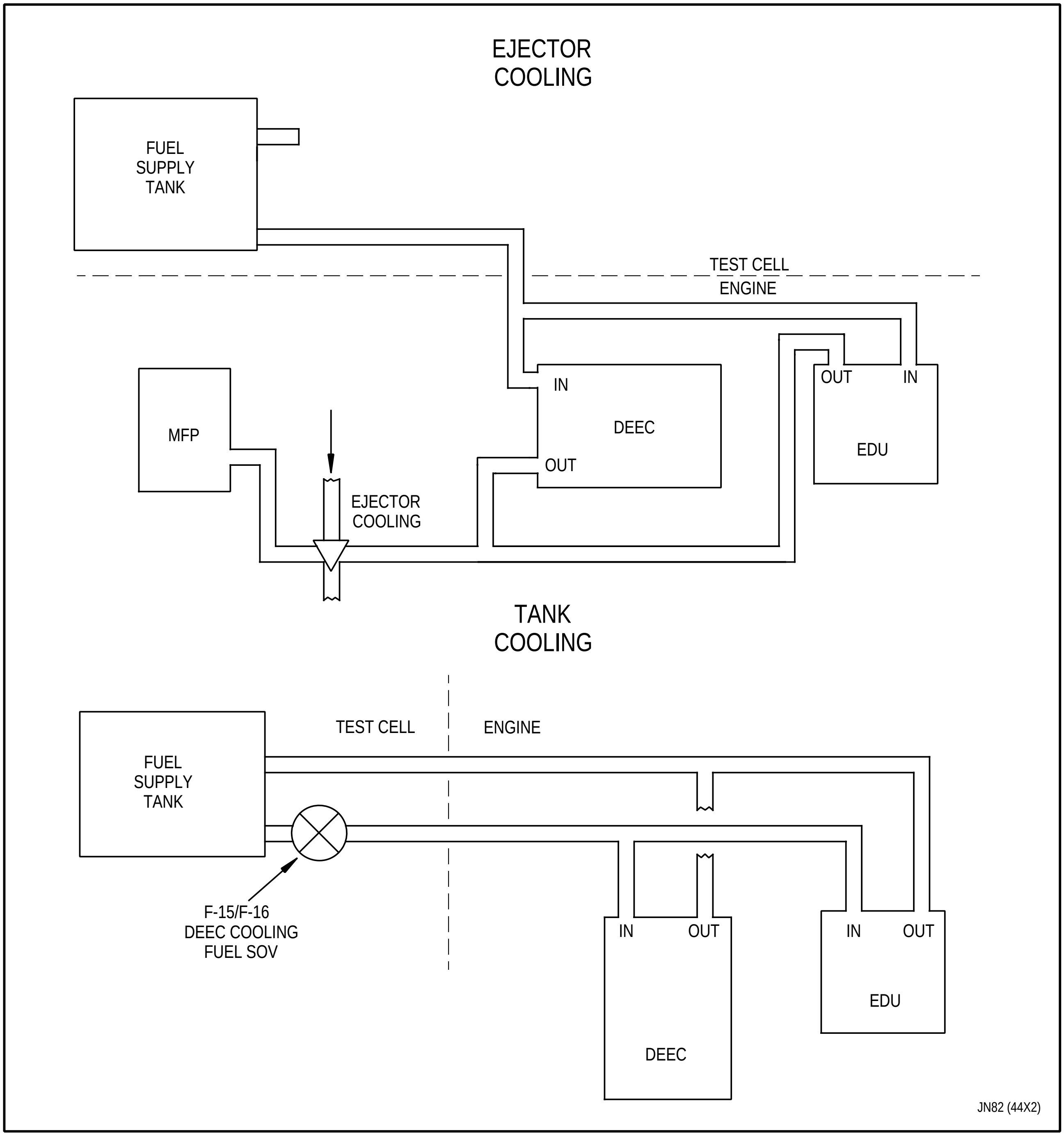


Figure 1. DEEC/EDU Cooling Configurations

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4370:
DEEC vs EDU ENGINE DISAGREEMENT

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	18	3 - 4	17		

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O.2J-F100-11-2
Idle Functional check	WP 216 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00
Illustrated Parts Breakdown	T.O. 2J-F100-54

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for DEEC vs EDU engine disagreement.

2. SYSTEM FAULT CODE 4370: DEEC vs EDU ENGINE DISAGREEMENT

(See Table 1.)

a. Description.

(1) When incorrect EDU or DEEC board as installed, a 4370 fault is declared.

b. Test Stand Observations:

(1) SYSTEM FAULT light ON.

Table 1. System Fault Code 4370:
DEEC vs EDU Engine Disagreement

Step	Procedure	Result	Corrective Action
1.	Verify if EDU or DEEC was recently replaced.	a. EDU or DEEC recently replaced. b. EDU or DEEC not recently replaced.	a. Replace component previously replaced. Go to step 3. b. Go to step 2.
2.	Verify correct EDU and DEEC part numbers are installed on engine. Refer to T.O. 2J-F100-54	a. Incorrect part numbers EDU or DEEC installed. b. Correct part numbers EDU and DEEC installed.	a. Replace with correct component as required. b. Go to step 3.

NOTE

Data not cleared from EDU may be interpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Ensure EDU data has been reviewed and stored per WP 651 00. Clear EDU data per WP 656 00. Go to step 4.		
4.	Perform IDLE functional check. Refer WP 216 00. Review EDU fault data per WP 651 00.	a. Fault does not repeat. b. Fault repeats.	a. Return engine to service. b. Replace components in the following order: • DEEC refer to T.O. 2J-F100-53-4, WP 007 00. • EDU refer to T.O. 2J-F100-53-4, WP 023 00 Go to Step 5.
5.	Clear EDU data per WP 656 00. Return to Step 4.		

WORK PACKAGE

TECHNICAL PROCEDURES

SYSTEM FAULT CODE 4410: MFC EDU SECONDARY MODE FEEDBACK CIRCUIT

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	18				
3 - 6	17				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Troubleshooting	T.O.2J-F100-11-2
Secondary Functional Check	WP 215 00
Engine Troubleshooting - General	WP 503 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Engine (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	SYSTEM FAULT CODE 4410: MFC EDU SECONDARY MODE FEEDBACK CIRCUIT MALFUNCTION	
	VOLT/OHMMETER	PSM-6 OR EQUIVALENT

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for aircraft switch.

2. SYSTEM FAULT CODE 4410: MFC EDU SECONDARY MODE FEEDBACK CIRCUIT MALFUNCTION

(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) EDU indication of engine mode, supplied from MFC SEC mode feedback switch circuit, is different than indication received, by EDU, from DEEC.

b. Engine Symptoms:

(1) Mode select switch is in Primary mode, engine is in Primary mode, and Secondary caution light is illuminated.
(or)

(2) Mode select switch is in SEC mode, engine is in SEC mode, but Secondary caution light is not illuminated.

c. Test Stand Observations:

(1) SYSTEM FAULT light on.

(2) SEC caution light does not match mode of operation.

d. Data Collected:

(1) Fault code(s) and time stamp(s).

Table 1. System Fault Code 4410:
EDU Secondary Feedback Circuit Malfunction

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Other events or faults are present.	a. Troubleshoot individual event or fault codes.
		b. No other events or faults are present.	b. Go to step 2.
2.	Check EDU MFC mode position switch. Perform the following resistance checks. See figure 1.		
	a. CONN P121 PINS 1. D to F	a.1 Resistance checks within limits: 1. GT 100,000 OHMS	a.1 Go to step b.
		a.2 Resistance checks out of limits.	a.2 Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 4.
	b. CONN P121 PINS 1. D to GND 2. D to E	b.1 Resistance checks within limits: 1. GT 100,000 OHMS 2. LT 5 OHMS	b.1 Reconnect P121 to EDU. Go to step 3.
		b.2 Resistance checks out of limits.	b.2 Go to step c.
	c. CONN J112 PINS 1. D to GND 2. D to C	c.1 Resistance checks within limits: 1. GT 100,000 OHMS 2. LT 5 OHMS	c.1 Replace power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 4.
		c.2 Resistance checks out of limits.	c.2 Reconnect P121 to EDU. Replace MFC. Refer to T.O. 2J-F100-53-4, WP 009 00. Go to step 4.

Table 1. System Fault Code 4410:
EDU Secondary Feedback Circuit Malfunction (continued)

Step	Procedure	Result	Corrective Action
3.	Check test stand SEC caution light power supply. Perform the following voltmeter checks. See figure 1. a. CONN P2 — PINS 1. 34 to 35	a. Voltmeter check within limits: 1. 24 to 30 VDC b. Voltmeter check out of limits.	a. Reconnect P2 connector. Go to step 4. b. Repair test stand power supply to SEC mode position signal switch. Refer to T.O. 33D4-6-685-1. Go to step 4.

NOTE

Data not cleared from EDU may be interpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
4.	Check that EDU data has been reviewed and stored per WP 651 00; then clear EDU data per WP 656 00. Go to step 5.		
5.	Perform SEC functional check per WP 215 00. Review EDU data per WP 651 00.	a. Fault Code 4410 does not repeat. b. Fault Code 4410 repeats.	a. Return engine to service. b. Replace components in the following order: • MFC Refer to T.O. 2J-F100-53-4, WP 009 00. • EDU Refer to T.O. 2J-F100-53-4, WP 023 00. • Power and speed cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to Step 6
6.	Clear EDU data per WP 656 00 and return to Step 5.		

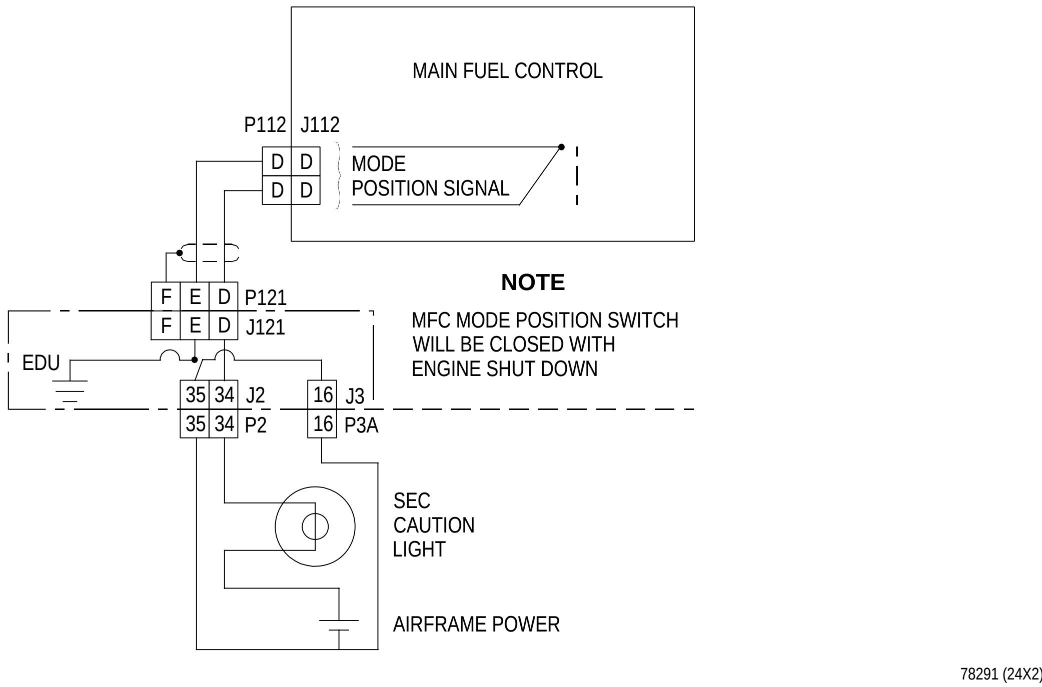


Figure 1. MFC EDU Secondary Mode Feedback

WORK PACKAGE

TECHNICAL PROCEDURES

EDU ADVISORY FAULT CODES 5001 - 5002: AUGMENTOR RECYCLE ADVISORIES

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 14

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	28	9	17	11 - 12	28
2	18	10	0	13	0
3 - 4	28	10A Added	28	14	28
5 - 8 Deleted	28	10B Blank Added	28	15 - 16 Added	28

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Acceleration/Deceleration Checks	WP 213 00
Engine Troubleshooting - General	WP 501 00
ENP vs. N1C2 Out of Limits, Intermediate (MIL) - Primary Mode	WP 515 00
Ignition System Anomaly	WP 518 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Augmentor Fuel System Analysis	WP 662 00
Ignition System Analysis	WP 664 00
DEEC Pressure Sensing System Analysis	WP 675 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Igniter - Spark, Gas Turbine Engine Augmentor	WP 025 00
Detector, Augmentor Light-off	WP 041 00
Engine	T.O. 2J-F100-53-5
Flameholder Assembly, Augmentor Igniter - Inspection	WP 422 00
Augmentor Spray Manifold	TBD

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
3	EDU ADVISORY FAULT CODE 5001: AUGMENTOR BLOWOUT/ RECYCLE	
	EDU ADVISORY FAULT CODE 5001: AUGMENTOR BLOWOUT/ RECYCLE	
	OHMMETER	PSM-6 OR
	OHMMETER	EQUIVALENT
4	EDU ADVISORY FAULT CODE 5002: AUGMENTOR NO-LIGHT/ RECYCLE	
	EDU ADVISORY FAULT CODE 5002: AUGMENTOR NO, LIGHT/ RECYCLE	
	OHMMETER	PSM-6 OR
	OHMMETER	EQUIVALENT

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for augmentor recycle advisories. If engine experienced augmentor no-light or blowout event, troubleshoot per WP 512 00.

2. Deleted.

Table 1. Deleted.

Pages 5 through 8 deleted.

3. EDU ADVISORY FAULT CODE 5001: AUGMENTOR BLOWOUT/RECYCLE.
(See Table 2.)

a. Cause of Advisory:

(1) Loss of augmentor combustion during normal augmentor operation. Blowouts are detected by DEEC via light off detector (LOD) signal or DEEC pressure and nozzle area parameters. After first blowout detection DEEC will attempt to relight (recycle) augmentor three times. Blowout events are recorded based upon the following criteria:

(a) An augmentor blowout was detected and either one of three allowable recycle attempts was successful or throttle was moved below mil power prior to completion of recycle attempts. This excludes ground operation and takeoff region (gear up plus 30 seconds).

(b) An augmentor blowout was detected in upper left hand portion of envelope (PT2 2.7 psia or less) and allowable recycle attempts may or may not have been successful.

b. Engine Symptoms:

(1) Augmentor recycles

c. Test Cell Observations:

(1) Fluctuating nozzle

d. Data recorded by EDU:

EMSE DISPLAY	DESCRIPTION
TIME	Time of occurrence of augmentor blowout
ALT	Altitude at time of augmentor blowout
MACH NO.	Mach number at time of augmentor blowout
PLA	PLA (agumentor rate limited) at time of augmentor blowout
PLART	PLA rate of change at time of augmentor blowout
PS2	Ps2 at time of augmentor blowout
TT2	Tt2 at time of augmentor blowout
AOA	Aircraft angle of attack at time of augmentor blowout
BETA	Aircraft angle of yaw at time of augmentor blowout
MODE	Control mode at time of augmentor blowout
A/I	Anti-ice (ON or OFF) at time of augmentor blowout

Table 2. EDU Advisory Code 5001:
Augmentor Blowout/Recycle

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Visually inspect augmentor area for damage:	a. Parts within limits.	a. Go to step 3.
	• Flameholder • Sprayrings (especially Segment 1 shield, and brackets)LOD lens (contaminated, broken)	b. Parts out of limits.	b. Repair or replace parts as required.
3.	Check security of LOD mounting and electrical cable connector.	a. LOD secure.	a. Go to step 4.
		b. LOD loose.	b. Repair or replace LOD as required.
4.	Determine when augmentor blowout occurred.	a. Blowout occurred during sequencing (augmentor lit).	a. Record blowout segment if known. Go to step 7.
		b. Blowout occurred augmentor initiation (no flame), or unknown.	b. Go to step 5.
5.	Run engine at IDLE. Cycle idle exhaust nozzle reset switch: RESET-OFF-RESET.	a. Exhaust nozzle operates normally.	a. Go to step 6.
		b. Exhaust nozzle binds or hesitates.	b. Disconnect primary flex shafts from exhaust nozzle actuator and CENC. Perform exhaust nozzle functional check.

Table 2. EDU Advisory Code 5001:
Augmentor Blowout/Recycle (continued)

Step	Procedure	Result	Corrective Action
6.	Perform DEEC pressure sensing system analysis.	a. System passes analysis.	a. Go to step 7.
		b. System fails analysis.	b. Replace components as required and go to step 7.

WARNING

Engine bleed air manifolds and tubing are hot. Do not touch these areas while checking for air leaks.

Step	Procedure	Result	Corrective Action
7.	Check 13th stage bleed, anti-ice, CENC, and augmentor fuel pump air tubes for leakage.	a. No leakage found.	a. Go to step 8.
		b. Leakage found.	b. Correct as required and go to step 8.

Table 2. EDU Advisory Code 5001:
Augmentor Blowout/Recycle (continued)

Step	Procedure	Result	Corrective Action
8.	Perform augmentor fuel system analysis.	a. System fails analysis.	a. Go to step 9.
		b. System passes analysis.	b. Repair or replace components as required.
9.	Perform snap acceleration/ deceleration functional check and check augmentor operation.	a. Augmentor operates normally.	a. Return engine to service.
		b. Augmentor does not operate normally.	b. Replace following components in order, repeating step 9 after each replacement until augmentor operates properly: • LOD • DEEC • AFC • Augmentor sprayrings (Replace manifold in which anomaly occurred. See step 4.)

4. EDU ADVISORY FAULT CODE 5002: AUGMENTOR NO-LIGHT/RECYCLE.
(See Figure 1 and Table 3.)

a. Cause of Advisory:

(1) The engine sequences to augmentor and augmentor combustion does not occur due to lack of ignition or proper fuel scheduling. No lights are detected by DEEC via augmentor light off detctor (LOD) signal or DEEC pressure and nozzle area parameters. After first no light detection, DEEC will attempt to light augmentor (recycle) three times. No light advisories are recorded based upon following criteria:

(a) An augmentor no light was detected and either one of three allowable DEEC recycle attempts was successful or throttle was moved below mil power prior to completion of recycle attempts. This excludes ground operation and takeoff region (gear up plus 30 seconds).

(b) An augmentor no light was detected in upper left hand portion of envelope (PT2 2.7 psia or less) and allowable recycle attempts may or may not have been successful.

b. Engine Symptoms:

(1) Augmentor recycles

c. Test Cell Observations:

(1) Fluctuating nozzle

d. Data recorded by EDU:

EMSE DISPLAY	DESCRIPTION
TIME	Time of occurrence of augmentor no-light
ALT	Altitude at time of augmentor no-light
MACH NO.	Mach number at time of augmentor no-light
PLA	PLA (agumentor rate limited) at time of augmentor no-light
PLART	PLA rate of change at time of augmentor no-light
PS2	Ps2 at time of augmentor no-light
TT2	Tt2 at time of augmentor no-light
AOA	Aircraft angle of attack at time of augmentor no-light
BETA	Aircraft angle of yaw at time of augmentor no-light
MODE	Control mode at time of augmentor no-light
A/I	Anti-ice (ON or OFF) at time of augmentor no-light

**Table 3. EDU Advisory Code 5002:
Augmentor No-Light/Recycle**

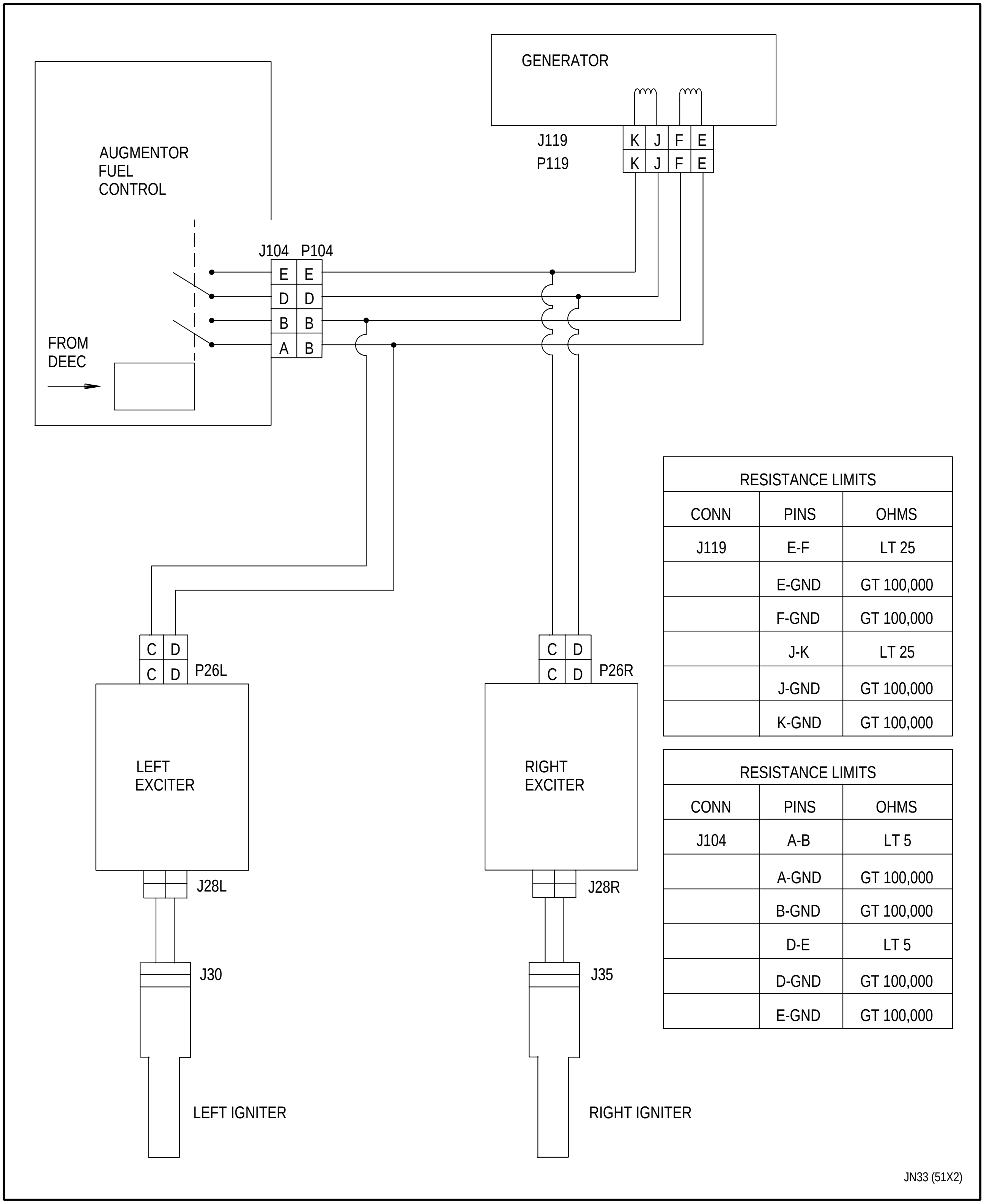
Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Visually inspect augmentor area for damage:	a. Parts within limits.	a. Go to step 3.
	• Flameholder • Flameholder Gap (especially between nosepiece and inner and outer shrouds within 2 inches of igniters) • Sprayrings (especially Segment 1 pintles, shield, brackets, and ignition orifice at igniters.) • Igniters (for burning or buckling) • LOD lens (contamination, broken)	b. Parts out of limits.	b. Repair or replace parts as required.
3.	Check security of LOD mounting and electrical cable connector.	a. LOD secure.	a. Go to step 4.
		b. LOD loose.	b. Repair or replace LOD as required.
4.	Visually inspect generator stator for:	a. Generator appears serviceable.	a. Go to step 5.
	• Loose mounting • Cracked housing • Loose connectors • Contamination or arcing inside connectors	b. Generator is unserviceable.	b. Clean connectors as required. Otherwise, repair or replace generator or ignition cable, as required.

Table 3. EDU Advisory Code 5002: Augmentor No-Light/Recycle (continued)

Step	Procedure	Result	Corrective Action
5.	Check generator stator ignition circuits. Perform following resistance checks (See figure 1.):		
	CONN J119 PINS	a. Resistance checks within limits:	a. Go to step 6.
	1. E to F	1. LT 25 OHMS	
	2. E to GND	2. GT 100,000 OHMS	
	3. F to GND	3. GT 100,000 OHMS	
	4. J to K	4. LT 25 OHMS	
	5. J to GND	5. GT 100,000 OHMS	
	6. K to GND	6. GT 100,000 OHMS	
		b. Resistance checks out of limits.	b. Remove and replace generator stator.

Table 4. EDU Advisory Code 5002: Augmentor No-Light/Recycle (continued)

Step	Procedure	Result	Corrective Action
6.	Perform augmentor ignition system functional check.	a. Augmentor ignites properly.	Go to step 7.
		b. Augmentor does not ignite properly.	b. Troubleshoot augmentor ignition anomaly.
7.	Perform snap acceleration/ deceleration functional check and check augmentor operation.	a. Augmentor operates properly.	Return engine to service.
		b. Augmentor does not operate properly.	b. Replace following components in order, repeating step 9 after each replacement until augmentor operates properly: • LOD • DEEC • Generator stator • Flameholder • AFC • Augmentor segment 1 sprayrings



RESISTANCE LIMITS		
CONN	PINS	OHMS
J119	E-F	LT 25
	E-GND	GT 100,000
	F-GND	GT 100,000
	J-K	LT 25
	J-GND	GT 100,000
	K-GND	GT 100,000

RESISTANCE LIMITS		
CONN	PINS	OHMS
J104	A-B	LT 5
	A-GND	GT 100,000
	B-GND	GT 100,000
	D-E	LT 5
	D-GND	GT 100,000
	E-GND	GT 100,000

Figure 1. Augmentor Ignition System Schematic - Generator Stator and AFC Ignition Switch Resistance Checks

WORK PACKAGE

TECHNICAL PROCEDURES

EDU ADVISORY FAULT CODES 5009 - 5017: DEEC VS EDU FTIT SIGNAL CIRCUIT AND FTIT PROBE SIGNALS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 14

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	24	9	24	10 - 14	23
3 - 8	23			15 - 24 Deleted	23

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
IDLE Functional Check	WP 216 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Thermocouple - Immersion, FTIT Sensing	WP 008 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
4	EDU ADVISORY FAULT CODE 5011 - 5017: FTIT 1 - FTIT 7 PROBE SIGNALS	
	OHMMETER	PSM-6 OR EQUIVALENT

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for FTIT system advisories.

2. EDU ADVISORY FAULT CODE 5009: DEEC VS EDU FTITA OUT OF LIMITS.

(See Table 1.)

a. Cause of Advisory:

(1) DEEC FTITA exceeds EDU FTITA sensor values by more than 50°F (28°C).

b. Engine Symptoms:

(1) None.

c. Test Stand Observation:

(1) None.

d. Data Collected:

(1) PDELATM - time at DEEC positive FTITA delta.

(2) Normal operating signals will be displayed as is.

(3) Time of occurrence.

Table 1. EDU Advisory Code 5009: DEEC vs EDU FTITA Out Of Limits

Step	Procedure	Result	Corrective Action
1.	Review fault and event data for other FTIT faults and advisories.	a. Other FTIT faults present.	a. Troubleshoot other individual faults.
		b. No other FTIT faults present.	b. Troubleshoot per fault code 4076.

3. EDU ADVISORY FAULT CODE 5010: DEEC VS EDU FTITB OUT OF LIMITS.

(See Table 2.)

a. Cause of Advisory.

(1) DEEC FTITB exceeds EDU FTITB sensor value by more than 50°F (28°C).

b. Engine Symptoms.

(1) None.

c. Test Cell Observations.

(1) None.

d. EDU Data Collected:

(1) PDELBTM - time at DEEC positive FTITB delta.

(2) Normal operating signals will be displayed as is.

(3) Time of occurrence.

Table 2. EDU Advisory Code 5010: DEEC vs EDU FTITB Out of Limits

Step	Procedure	Result	Corrective Action
1.	Review fault and event data for other FTIT faults and advisories.	a. Other FTIT faults present.	a. Troubleshoot other individual faults.
		b. No other FTIT faults present.	b. Troubleshoot per fault code 4077.

4. EDU ADVISORY FAULT CODE 5011 - 5017: FTIT 1 - FTIT 7 PROBE SIGNALS.
(See figures 1 and 2 and Tables 3 through 9.)

a. Cause of Fault:

(1) FTIT probe signal out of -65° to 2498°F (-54° to 1370°C) range.

(2) FTIT probe indicates slow response. Response is calculated by recording FTIT probe reading at 0, 5, and 30 seconds after acceleration to Intermediate (MIL) initiated.

b. Engine Symptoms (possible):

(1) FTIT spread out of range.

c. Test Cell Observations (possible):

(1) Erroneous FTIT readings.

(2) SYSTEM FAULT light on and System Fault Code 4075 present if three or more FTIT probes malfunction.

d. Check specific probe circuits per tables 3 through 9.

Table 3. EDU Advisory Fault Code 5011: No. 1 FTIT Probe Signal

Step	Procedure	Result	Corrective Action
1.	Check FTIT circuit. Remove P48 from J48 on EDU. Perform resistance checks as follows: (See figures 1 and 2.)		
	a. CONN P48 PIN 1. 1 to 9	a.1. Resistance checks within limits: 1. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Remove temperature cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 3.
	b. CONN P48 PIN 1. 1 to 8 2. 8 to GND	b.1. Resistance checks within limits: 1. LT 20 OHMS 2. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Remove P38 cap from No. 1 FTIT probe. Go to c.
	c. CONN J38 PIN 1. B to C 2. B to GND 3. C to GND	c.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 750,000 OHMS 3. GT 750,000 OHMS	c.1. Replace temperature cable.
		c.2. Resistance checks out of limits.	c.2. Replace No. 1 FTIT probe.

Table 3. EDU Advisory Fault Code 5011: No. 1 FTIT Probe Signal (continued)

Step	Procedure	Result	Corrective Action
2.	Perform FTIT probe seating check on No. 1 probe. Refer to T.O. 2J-F100-53-4, WP 008 00.	a. FTIT probe not seated properly. b. FTIT probe seated properly.	a. Remove and check No. 1 FTIT probe. Go to step 3. b. Go to step 3.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored; then clear EDU data using EMSE.		
4.	Perform IDLE functional check per WP 216 00. Check for advisory fault code 5011.	a. Advisory fault code 5011 does not repeat. b. Advisory fault code 5011 repeats.	a. Return engine to service. b. Replace components in the following order until engine operates properly and repeat steps 3 and 4. • No. 1 FTIT probe • Temperature Cable • EDU

Table 4. EDU Advisory Fault Code 5012: No. 2 FTIT Probe Signal

Step	Procedure	Result	Corrective Action
1.	Check FTIT circuit. Remove P48 from J48 on EDU. Perform resistance checks as follows: (See figures 1 and 2.)		
	a. CONN P48 PIN 1. 2 to 9	a.1. Resistance checks within limits: 1. GT 100,000 OHMS a.2. Resistance checks out of limits.	a.1. Go to b. a.2. Replace temperature cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 3.
	b. CONN P48 PIN 1. 2 to 8 2. 8 to GND	b.1. Resistance checks within limits: 1. LT 20 OHMS 2. GT 100,000 OHMS b.2. Resistance checks out of limits.	b.1. Go to step 2. b.2. Remove P39 cap from No. 2 FTIT probe. Go to c.
	c. CONN J39 PIN 1. B to C 2. B to GND 3. C to GND	c.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 750,000 OHMS 3. GT 750,000 OHMS c.2. Resistance checks out of limits.	c.1. Replace temperature cable. c.2. Replace No. 2 FTIT probe.
2.	Perform FTIT probe seating check on No. 2 probe. Refer to T.O. 2J-F100-53-4, WP 008 00.	a. FTIT probe is not seated properly. b. FTIT probe is seated properly.	a. Remove and check No. 2 FTIT probe. Go to step 3. b. Go to step 3.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored; then clear EDU data using EMSE.		
4.	Perform IDLE functional check per WP 216 00. Check for advisory fault code 5012.	a. Advisory fault code 5012 does not repeat. b. Advisory fault code 5012 repeats.	a. Return engine to service. b. Replace components in the following order until engine operates properly and repeat steps 3 and 4. • No. 2 FTIT probe • Temperature cable • EDU

Table 5. EDU Advisory Fault Code 5013: No. 3 FTIT Probe Signal

Step	Procedure	Result	Corrective Action
1.	Check FTIT circuit. Remove P48 from J48 on EDU. Perform resistance checks as follows: (See figures 1 and 2.)		
	a. CONN P48 PIN 1. 3 to 9	a.1. Resistance checks within limits: 1. GT 100,000 OHMS a.2. Resistance checks out of limits.	a.1. Go to b. a.2. Replace temperature cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 3.
	b. CONN P48 PIN 1. 3 to 8 2. 8 to GND	b.1. Resistance checks within limits: 1. LT 20 OHMS 2. GT 100,000 OHMS b.2. Resistance checks out of limits.	b.1. Go to step 2. b.2. Remove P40 cap from No. 3 FTIT probe. Go to c.
	c. CONN J40 PIN 1. B to C 2. B to GND 3. C to GND	c.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 750,000 OHMS 3. GT 750,000 OHMS c.2. Resistance checks out of limits.	c.1. Replace temperature cable. c.2. Replace No. 3 FTIT probe.
2.	Perform FTIT probe seating check on No. 3 probe. Refer to T.O. 2J-F100-53-4, WP 008 00.	a. FTIT probe not seated properly. b. FTIT probe seated properly.	a. Remove and check No. 3 FTIT probe. Go to step 3. b. Go to step 3.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored; then clear EDU data using EMSE.		
4.	Perform IDLE functional check per WP 216 00. Check for advisory fault code 5013.	a. Advisory fault code 5013 does not repeat. b. Advisory fault code 5013 repeats.	a. Return engine to service. b. Replace components in the following order until engine operates properly and repeat steps 3 and 4. • No. 3 FTIT probe • Temperature cable • EDU

Table 6. EDU Advisory Fault Code 5014: No. 4 FTIT Probe Signal

Step	Procedure	Result	Corrective Action
1.	Check FTIT circuit. Remove P48 from J48 on EDU. Perform resistance checks as follows: (See figures 1 and 2.)		
	a. CONN P48 PIN 1. 4 to 9	a.1. Resistance checks within limits: 1. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace temperature cable. Refer to T.O. 2J-F100-53-4, Go to step 3.
	b. CONN P48 PIN 1. 4 to 8 2. 8 to GND	b.1. Resistance checks within limits: 1. LT 20 OHMS 2. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Remove P41 cap from No. 4 FTIT probe. Go to c.
	c. CONN J41 PIN 1. B to C 2. B to GND 3. C to GND	c.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 750,000 OHMS 3. GT 750,000 OHMS	c.1. Replace temperature cable.
		c.2. Resistance checks out of limits.	c.2. Replace No. 4 FTIT probe.
2.	Perform FTIT probe seating check on No. 4 probe. Refer to T.O. 2J-F100-53-4, WP 008 00.	a. FTIT probe not seated properly.	a. Remove and check No. 4 FTIT probe. Go to step 3.
		b. FTIT probe seated properly.	b. Go to step 3.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored; then clear EDU data using EMSE.		
4.	Perform IDLE functional check per WP 216 00. Check for advisory fault code 5014.	a. Advisory Fault Code 5014 does not repeat.	a. Return engine to service.
		b. Advisory Fault Code 5014 repeats.	b. Replace components in the following order until engine operates properly and repeat steps 3 and 4. • No. 4 FTIT Probe • Temperature Cable • EDU

Table 7. EDU Advisory Fault Code 5015: No. 5 FTIT Probe Signal

Step	Procedure	Result	Corrective Action
1.	Check FTIT circuit. Remove P48 from J48 on EDU. Perform resistance checks as follows: (See figures 1 and 2.)		
	a. CONN P48 PIN 1. 5 to 9	a.1. Resistance checks within limits: 1. GT 100,000 OHMS a.2. Resistance checks out of limits.	a.1. Go to b. a.2. Replace temperature cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 3.
	b. CONN P48 PIN 1. 5 to 8 2. 8 to GND	b.1. Resistance checks within limits: 1. LT 20 OHMS 2. GT 100,000 OHMS b.2. Resistance checks out of limits.	b.1. Go to step 2. b.2. Remove P42 cap from No. 6 FTIT probe. Go to c.
	c. CONN J42 PIN 1. B to C 2. B to GND 3. C to GND	c.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 750,000 OHMS 3. GT 750,000 OHMS c.2. Resistance checks out of limits.	c.1. Replace temperature cable. c.2. Replace No. 5 FTIT probe.
2.	Perform FTIT probe seating check on No. 5 probe. Refer to T.O. 2J-F100-53-4, WP 008 00.	a. FTIT probe not seated properly. b. FTIT probe seated properly.	a. Remove and check No. 5 FTIT probe. Go to step 3. b. Go to step 3.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored; then clear DEEC and EDU data using EMSE.		
4.	Perform IDLE functional check per WP 216 00. Check for advisory fault code 5015.	a. Advisory fault code 5015 does not repeat. b. Advisory Fault Code 5015 repeats.	a. Return engine to service. b. Replace components in the following order until engine operates properly and repeat steps 3 and 4. • No. 5 FTIT Probe • Temperature Cable • EDU

Table 8. EDU Advisory Fault Code 5016: No. 6 FTIT Probe Signal

Step	Procedure	Result	Corrective Action
1.	Check FTIT circuit. Remove P48 from J48 on EDU. Perform resistance checks as follows: (See figures 1 and 2.)		
	a. CONN P48 PIN 1. 6 to 9	a.1. Resistance checks within limits: 1. GT 100,000 OHMS	a.1. Go to b.
		a.2. Resistance checks out of limits.	a.2. Replace temperature cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 3.
	b. CONN P48 PIN 1. 6 to 8 2. 8 to GND	b.1. Resistance checks within limits: 1. LT 20 OHMS 2. GT 100,000 OHMS	b.1. Go to step 2.
		b.2. Resistance checks out of limits.	b.2. Remove P43 cap from No. 6 FTIT probe. Go to c.
	c. CONN J43 PIN 1. B to C 2. B to GND 3. C to GND	c.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 750,000 OHMS 3. GT 750,000 OHMS	c.1. Replace temperature cable.
		c.2. Resistance checks out of limits.	c.2. Replace No. 6 FTIT probe.
2.	Perform FTIT probe seating check on No. 6 probe. Refer to T.O. 2J-F100-53-4, WP 008 00.	a. FTIT probe not seated properly.	a. Remove and check No. 6 FTIT probe. Go to step 3.
		b. FTIT probe seated properly.	b. Go to step 3.

NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored; then clear DEEC and EDU data using EMSE.		
4.	Perform IDLE functional check per WP 216 00. Check for advisory fault code 5016.	a. Advisory fault code 5016 does not repeat.	a. Return engine to service.
		b. Advisory fault code 5016 repeats.	b. Replace components in the following order until engine operates properly and repeat steps 3 and 4. • No. 6 FTIT Probe • Temperature Cable • EDU

Table 9. EDU Advisory Fault Code 5017: No. 7 FTIT Probe Signal

Step	Procedure	Result	Corrective Action
1.	Check FTIT circuit. Remove P48 from J48 on EDU. Perform resistance checks as follows: (See figures 1 and 2.)		
	a. CONN P48 PIN 1. 7 to 9	a.1. Resistance checks within limits: 1. GT 100,000 OHMS a.2. Resistance checks out of limits.	a.1. Go to b. a.2. Replace temperature cable. Refer to T.O. 2J-F100-53-4, WP 019 00. Go to step 3.
	b. CONN P48 PIN 1. 7 to 8 2. 8 to GND	b.1. Resistance checks within limits: 1. LT 20 OHMS 2. GT 100,000 OHMS b.2. Resistance checks out of limits.	b.1. Go to step 2. b.2. Remove P44 cap from No. 7 FTIT probe. Go to c.
	c. CONN J44 PIN 1. B to C 2. B to GND 3. C to GND	c.1. Resistance checks within limits: 1. LT 5 OHMS 2. GT 750,000 OHMS 3. GT 750,000 OHMS c.2. Resistance checks out of limits.	c.1. Replace temperature cable. c.2. Replace No. 7 FTIT probe.
2.	Perform FTIT probe seating check on No. 7 probe. Refer to T.O. 2J-F100-53-4, WP 008 00.	a. FTIT probe not seated properly. b. FTIT probe seated properly.	a. Remove and check No. 7 FTIT probe. Go to step 3. b. Go to step 3.

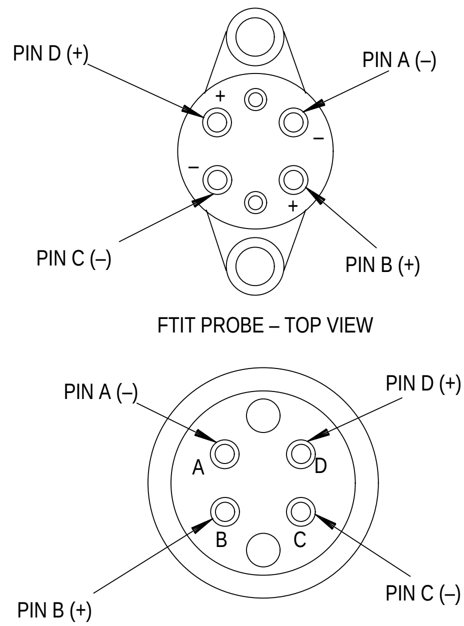
NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

Step	Procedure	Result	Corrective Action
3.	Check that EDU data has been reviewed and stored; then clear EDU data using EMSE.		
4.	Perform IDLE functional check per WP 216 00. Check for advisory fault code 5017.	a. Advisory fault code 5017 does not repeat. b. Advisory fault code 5017 repeats.	a. Return engine to service. b. Replace components in the following order until engine operates properly and repeat steps 3 and 4. • No. 7 FTIT probe • Temperature cable • EDU

NOTE

VERIFY FTIT PROBE PIN DESIGNATIONS BY COMPARING THEM TO LETTERED PINS IN HARNESS CAP



FTIT HARNESS CAP – INSIDE VIEW

RESISTANCE LIMITS AT FTIT PROBE		
CONNECTORS	PINS	OHMS
J38 THRU J44	B TO C	LT 5
	B TO GND	GT 750,000
	A TO D	LT 5
	A TO GND	GT 750,000
	A TO C	GT 750,000

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Figure 1. FTIT Probe Circuits

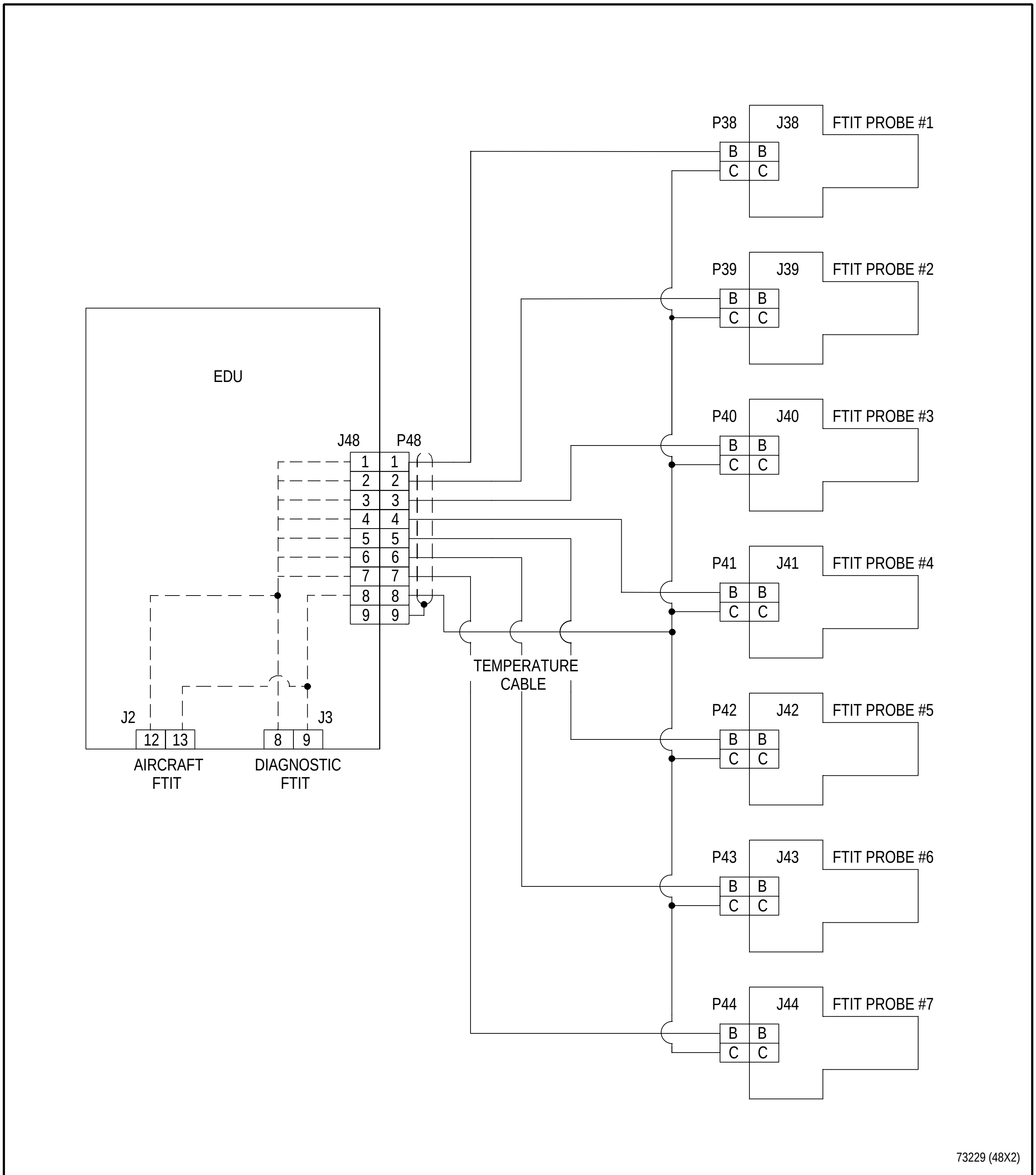


Figure 2. EDU FTIT Indicator Circuit (Sheet 1 of 2)

FTIT INDICATOR CIRCUIT RESISTANCE LIMITS		
	P48	OHMS
ALL PROBES	8–GND AND 8–9	GT 100,000
PROBE 1	1–8	LT 20
PROBE 2	2–8	LT 20
PROBE 3	3–8	LT 20
PROBE 4	4–8	LT 20
PROBE 5	5–8	LT 20
PROBE 6	6–8	LT 20
PROBE 7	7–8	LT 20
PROBE 1	1–9	GT 100,000
PROBE 2	2–9	GT 100,000
PROBE 3	3–9	GT 100,000
PROBE 4	4–9	GT 100,000
PROBE 5	5–9	GT 100,000
PROBE 6	6–9	GT 100,000
PROBE 7	7–9	GT 100,000

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Figure 2. EDU FTIT Indicator Circuit (Sheet 2 of 2)

WORK PACKAGE

TECHNICAL PROCEDURES

EDU ADVISORY FAULT CODE 7001: TRANSIENT DATA PRESENT

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 3	0				
4 Blank	0				

REFERENCE MATERIAL REQUIRED

None

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains procedures to inform maintenance personnel of the presence of transient data.

2. EDU Advisory Code 7001.

a. Description:

(1) If pilot selects data record (F-16 only), or one of the following occurs, EDU will collect approximately 4.5 seconds of data (3.5 seconds before incident and one second after incident):

- Auto transfer to Secondary Mode
- Pre-programmed fault
- 1000-series EDU Event Code(s)

(2) This data may assist in troubleshooting engine events.

WORK PACKAGE

TECHNICAL PROCEDURES

EDU ADVISORY FAULT CODE 5140: AIRCRAFT TYPE DISAGREEMENT

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 8

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Downloading and Reviewing Data Using CEDS	WP 651 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Clearing Engine Faults/Events and Data Using CEDS	WP 656 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	EDU Advisory Fault Code 5140: Aircraft Type Disagreement	
	Ohmmeter	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for aircraft type disagreement (DEEC indication versus EDU indication).

2. EDU ADVISORY FAULT CODE 5140: AIRCRAFT TYPE DISAGREEMENT.

(See Figure 1 and Table 1.)

a. Cause of Advisory:

(1) EDU aircraft type indication differs with DEEC aircraft type indication.

(2) The DEEC determines aircraft type via aircraft (F15 = J-1 pins 7-8 and pins 30-31 both open, F16 = both closed) and sends its indication over UART to the EDU.

(3) The EDU determines aircraft type by the engine position number input into the EDU for documentary data (1 = single engine/F16, 2 = left engine/F15, and 3 = right engine/F15).

(4) Once DEEC communication is established, the EDU makes a one time check on the DEEC aircraft type indication versus the EDU aircraft type indication. If they differ, the EDU sets a fault code and uses the DEEC indication.

b. Engine Symptoms:

(1) None

c. Test Cell Observations:

(1) None

d. Data Collected:

(1) Fault code and time stamp

Table 1. EDU Advisory Code 5140: Aircraft Type Disagreement

Step	Procedure	Result	Corrective Action
1.	Review event and fault data.	a. Events or faults present.	a. Troubleshoot event or fault codes.
		b. No events or faults present.	b. Go to step 2.
2.	Review documentary data. Determine engine position stored in EDU documentary data.	a. Engine position agrees with aircraft identification switch position. (Left(2)/right(3) - F15 or 1 for F16).	a. Go to step 3.
		b. Engine position does not agree with aircraft identification switch position.	b. Correct EDU documentary data.
3.	Perform following resistance checks. Note position of aircraft ID switch (See figure 1.):		
	a. CONN P82 PINS	a.1. Resistance checks within limits:	a.1. Go to b.
	A/C ID SWITCH		
	1. t to p	1. GT 100,000 OHMS	
	2. z to p	2. GT 100,000 OHMS	
	3. X to p	3. GT 100,000 OHMS	
	4. AA to p	4. GT 100,000 OHMS	
		a.2. Resistance checks out of limits.	a.2. Replace power and speed cable.
	b. CONN P82 PINS	b.1. Resistance checks within limits:	b.1. Go to step 4.
	A/C ID SWITCH: F-15		
	1. t to X	1. GT 100,000 OHMS	
	2. z to AA	2. GT 100,000 OHMS	
	3. t to GND	3. GT 100,000 OHMS	
	4. X to GND	4. GT 100,000 OHMS	
	5. z to GND	5. GT 100,000 OHMS	
	6. AA to GND	6. GT 100,000 OHMS	

Table 1. EDU Advisory Code 5140: Aircraft Type Disagreement (continued)

Step	Procedure	Result	Corrective Action
3. (cont'd)	A/C ID SWITCH: F-16		
	7. t to X	7. LT 5 OHMS	
	8. z to AA	8. LT 5 OHMS	
	9. t to GND	9. GT 100,000 OHMS	
	10. z to GND	10. GT 100,000 OHMS	
		b.2. Resistance checks out of limits.	b.2. Disconnect P1 from J1. Go to c.
	c. CONN P1 PINS	c.1. Resistance checks within limits:	c.1. Replace power and speed cable.
	A/C ID SWITCH: F-15		
	1. 7 to 8	1. GT 100,000 OHMS	
	2. 30 to 31	2. GT 100,000 OHMS	
	3. 7 to GND	3. GT 100,000 OHMS	
	4. 8 to GND	4. GT 100,000 OHMS	
	5. 30 to GND	5. GT 100,000 OHMS	
	6. 31 to GND	6. GT 100,000 OHMS	
	A/C ID SWITCH: F-16		
	7. 7 to 8	7. LT 5 OHMS	
	8. 30 to 31	8. LT 5 OHMS	
	9. 7 to GND	9. GT 100,000 OHMS	
	10. 30 to GND	10. GT 100,000 OHMS	
		c.2. Resistance checks out of limits.	c.2. Repair test cell wiring as required.

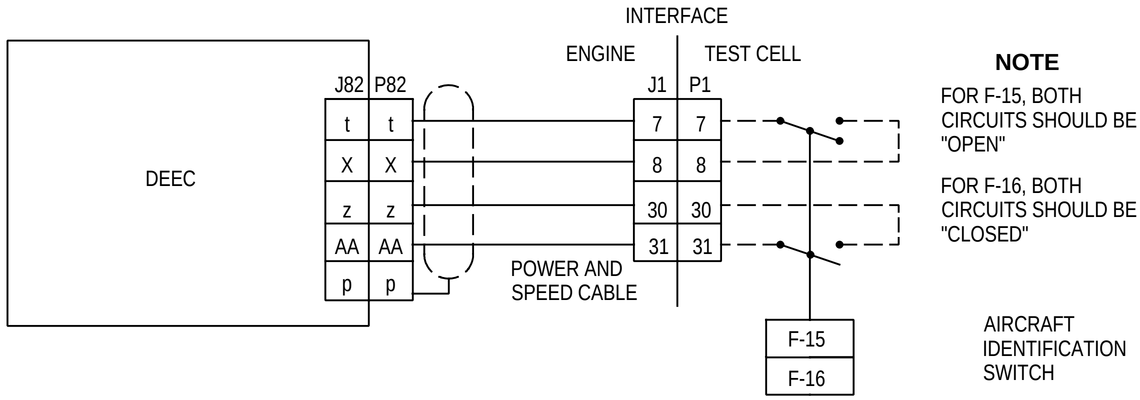
NOTE

Data not cleared from EDU may be misinterpreted as repeating fault or event.

4.	Check that EDU data has been reviewed and stored; then clear data.		

Table 1. EDU Advisory Code 5140: Aircraft Type Disagreement (continued)

Step	Procedure	Result	Corrective Action
5.	Perform IDLE functional check. Check for Advisory Code 5140. Replace components in following order until engine operates properly:	a. Advisory Fault Code 5140 does not repeat.	Return engine to service.
	• Test cell aircraft identification switch • Power and speed cable • EDU • DEEC	b. Advisory Fault Code 5140 repeats.	b. Replace next component. Repeat steps 4 and 5.



A/C ID SWITCH RESISTANCE LIMITS	
PINS (P82)	OHMS
t-p	GT 100,000
z-p	GT 100,000
X-p	GT 100,000
AA-p	GT 100,000

F-15 POSITION RESISTANCE LIMITS		
PINS (P82)	PINS (P1)	OHMS
t-X	7-8	GT 100,000
z-AA	30-31	GT 100,000
t-GND	7-GND	GT 100,000
X-GND	8-GND	GT 100,000
z-GND	30-GND	GT 100,000
AA-GND	31-GND	GT 100,000

F-16 POSITION RESISTANCE LIMITS		
PINS (P82)	PINS (P1)	OHMS
t-X	7-8	LT5
z-AA	30-31	LT5
t-GND	7-GND	GT 100,000
z-GND	30-GND	GT 100,000

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Figure 1. Aircraft Identification Circuit

WORK PACKAGE

TECHNICAL PROCEDURES

ADVISORY CODE 5170:
EDU/DEEC COMMUNICATION (UART) INTERUPTION

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	18				
3 - 4	17				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Troubleshooting	T.O.2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
System Fault Code 4210: EDU/DEEC Communication	WP 625 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. DEEC sends digital fault flags and operating/scheduling parameters to EDU through UART (Universal Asynchronous Receiver/Transmitter) via engine Power and Speed cable. UART Advisory 5170 indicates short term interruption of this communication. When this condition occurs F-16 and M-37 test stand Engine Caution Light illuminates and F-16 ENG PFL DGRD (Engine PFL Degrade) PFL is displayed (there is no indication of this condition in F-15 cockpit) This advisory is intended to identify cause for Engine Caution Light/PFL when indicators are noted by pilot/ operator.

2. ADVISORY CODE 5170: EDU/DEEC COMMUINCATION (UART) INTERRUPTION

(See Table 1.)

a. Cause of Fault:

(1) EDU does not receive UART data for more than 3/4 seconds but less than 30 seconds (if this condition exist for more than 30 seconds System Fault Code 4210 DEEC/EDU Communication (UART) fault will be recorded).

b. Engine Symptoms:

(1) None.

c. Test Stand Observations:

(1) ENGINE CAUTION light on.

d. Data recorded by EDU:

EMSE DISPLAY	DESCRIPTION
N1	N1 at UART Advisory
N2	N2 at UART Advisory
FTIT	FTIT at UART Advisory
AJ	AJ at UART Advisory
MOP	Main Oil Pressure
MODE	GG Mode
TIME	Time of Advisory

Table 1. ADVISORY Code 5170:
EDU/DEEC Communication (UART) Interruption

Step	Procedure	Result	Corrective Action
1.	Troubleshoot per WP 625 00, System Fault Code 4210 EDU/ DEEC Communication (UART).		

WORK PACKAGE

TECHNICAL PROCEDURES

ADVISORY CODE 5180:
Mn SIGNAL

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE SWP PAGES

Total Number of Pages in this SWP is 4

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	18				
3 - 4	17				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Troubleshooting	T.O.2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
System Fault Code 4180: Mn Signal	WP 620 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T. O. No.	Date	Level	Title (ECP No.)
5E1-2-15-507	15 JUN 96	O/I	Upgrade of Engine Diagnostic Unit (EDU) to 3.1.0 Logic, F100-PW-229 Engine, F-15/F-16 Aircraft (ECP 95QA001C1)

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

None

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. Mach number (Mn) is provided to DEEC by an aircraft or test stand simulator. Mn normal range is 0.15 to 2.80 Mn. Mn Advisory 5180 indicates short term Mn signal fault. When this condition occurs F-15 ENG CONTR illuminates, F-16 Engine Caution Light is illuminated/Aug-Mn PFL is displayed and M-37 test stand Engine Caution and Aug-Mn Lights are illuminated. This adisory is intended to identify causes for these indicators when they are noted by pilot/operator.

2. ADVISORY CODE 5180: Mn INPUT TO DEEC SHORT TERM OUT OF RANGE.

(See Figure 1 and Table 1.)

a. Cause of Fault:

(1) One or more of following conditions occured:

- No Mn signal received by DEEC
- Mn signal out of normal range
- Mn rate of change exceeds allowable rate (F-15 only)

and were recorded based on ground or flight criteria listed below:

(a) Ground operation: First occurence of Mn fault for more than 60 seconds or second occurence of Mn fault.

(b) Flight operation: Set on first occurence of Mn out of range.

b. Engine Symptoms:

(1) Supersonic: Loss of Mn lockout protection causing potential stall during Decel.

(2) Subsonic: None.

(3) Air Start: potential increase in start time.

c. Test Stand Observations:

(1) SYSTEM FAULT light on.

(2) Aug/Mn light on.

(3) ENGINE CAUTION light on.

d. Data recorded by EDU:

EMSE DISPLAY	DESCRIPTION
Mn ADVIS	Number of times (up to 10) condition existed

**Table 1. ADVISORY Code 5180:
Mn Input To DEEC Short Term Out Of Range**

Step	Procedure	Result	Corrective Action
1.	Troubleshoot per WP 620 00, System Fault Code 4180 Mn Input to DEEC Out of Range.		

WORK PACKAGE

TECHNICAL PROCEDURES

EDU TEST PROCEDURES USING EAU

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 12	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test ------------------------------------	T.O. 2J-F100-11-2
Engine Troubleshooting - General -------------------	WP 501 00
EAU Built-In-Test --------------------------------	WP 654 00
Engine Analyzer Unit - Operation Instructions (This unit is designated as a jet engine analyzer unit in referenced technical manual.) ----------------------------	T.O. 33D4-6-684-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

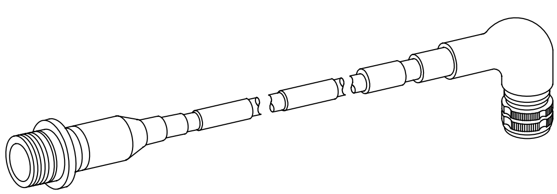
EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

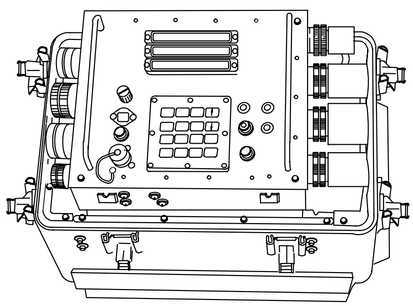
Paragraph	Function - Tool Nomenclature	Tool Number
2	EDU Test Procedure Using EAU	
	Interface cables ----------------------	PWA 56032 PWA 56033
	Engine analyzer unit --------------------	PWA 56084

ILLUSTRATED SUPPORT EQUIPMENT



PWA 56033 –C

Figure T1. PWA 56032/PWA 56033 Interface Cable (Typical)



PWA 56016 –C

Figure T2. PWA 56084 Engine Analyzer Unit

1. INTRODUCTION.

a. This work package provides an Engine Diagnostic Unit (EDU) functional test using PWA 56032 and PWA 56033 interface cables, and PWA 56084 Engine Analyzer Unit (EAU).

b. Specific instructions are provided for connecting engine, EAU, power source, and ground connections to permit EAU SELF-TEST, BUILT-IN-TEST, signals check, and EDU test.

2. EDU TEST PROCEDURE USING EAU.

(See Figures 1 and 2 and Table 1.)

a. Perform EDU test procedure using PWA 56084 EAU per table 1.

Table 1. EDU Test Procedure

Step	Procedure	Normal Indication	Other Indication/Required Action
A.	EAU SETUP (See figure 1.)		
1.	Remove EAU cover.		

WARNING

To prevent injury to personnel or damage to EAU, ensure EAU is properly grounded before applying electrical power.

Step	Procedure	Normal Indication	Other Indication/Required Action
2.	Properly ground EAU.		

CAUTION

Ensure EAU PWR switch is OFF before connecting or disconnecting electrical power.

Step	Procedure	Normal Indication	Other Indication/Required Action
3.	Turn EAU PWR switch OFF.		

CAUTION

- PWA 56032 cable set case step-down transformer must be used if EAU power source is 220 Vac. Failure to use transformer may damage EAU, even with EAU PWR switch OFF.
- Do not use transformer if EAU power supply is 110 to 125 Vac. Use of step-down transformer with 110 Vac power source will cause erroneous EAU operation and may damage EAU.

Step	Procedure	Normal Indication	Other Indication/Required Action
4.	Connect W1 power cable to EAU J1 connector. See figure 1.		
5.	Ensure power supply is 110 to 125 Vac.	a. Voltage and frequency within limits.	a. Go to step 6.
		b. Voltage and frequency out of limits.	b. Repair or replace power source.
6.	Plug W1 cable into power supply.		

Table 1. EDU Test Procedure (continued)

A.6.a.	If step-down transformer is used, plug W1 cable into Hubble plug of transformer.		
6.b.	Turn transformer power switch OFF.		
6.c.	Connect transformer to 220 Vac power supply.		

CAUTION

Loss of engine-driven electrical power due to fuel starvation may cause a destructive current surge through the EAU. Ensure adequate fuel supply before starting.

6.d.	Turn transformer ON.		
B.	EAU SELF TESTS		
1.	Turn EAU PWR switch ON.	a. EAU SELF-TEST IN PROGRESS- WAIT	
		EAU SELF-TEST PASSED EAU ID 1-020100	a. EAU SELF-TEST FAILURE xxxx TEST a.1. Replace EAU.
2.	Press YES/CONT button.	a. INDICATE EAU LOCATION 1-FLIGHT LINE	
		2-TEST CELL 3-BENCH TEST	

Table 1. EDU Test Procedure (continued)

Step	Procedure	Normal Indication	Other Indication/ Required Action
B.3.	Determine cable set in use: PWA 56032 - Flight line PWA 56033 - Test cell Press corresponding number and ENTR buttons.	a. # - xxxx xxxx 1-BUILT-IN-TEST 2-REVIEW DATA 3-COMPONENT TEST 4-REAL TIME READ 5-MEMORY R/W 6-REMOTE MODE b. 7-DEEC/EDU CLEAR 8-DOC DATA 9-DATA TRANSFER	
C.	EDU FUNCTIONAL TEST		
1.	Select COMPONENT TEST. Press 3 and ENTR buttons.	a. 3-COMPONENT TEST 1-DEEC TEST 2-EDU TEST 3-LOD TEST	

Table 1. EDU Test Procedure (continued)

Step	Procedure	Normal Indication	Other Indication/ Required Action
C.2.	Select EDU TEST. Press 2 and ENTR buttons.	a. 2-EDU TEST	

CAUTION

Ensure EDU is not powered when connecting cable W3 to engine J146.

Step	Procedure	Normal Indication	Other Indication/ Required Action
		PWA 56032 cable set CONNECT CABLE W3 TO EAU J3 AND ENGINE J146 - OR - PWA 56033 cable set CHECK CONNECTION W3 TO EAU J3 AND ENGINE J146	a. BUILT-IN-TEST FAILURE - EDU POWER TEST a.1. Replace EAU.
3.	If not accomplished, connect W3 cable as depicted in figure 2. Press YES/CONT button.	a. CONNECT CABLES W3 AND W121 TO EAU AND EDU P121 TO EDU J121 P82 TO J82 AND P82M to EAU J82M	

Table 1. EDU Test Procedure (continued)

Step	Procedure	Normal Indication	Other Indication/ Required Action
4.	Connect W121 cable to W82 cable. Remove P121 from EDU. Connect W121 and W82 cables to EDU and EAU, respectively (See figure 2).		
	Press YES.CONT button.	a. EDU TEST IN PROGRESS- WAIT	
		EDU TEST PASS-CLEAR DATA? Y OR N	a. EDU DATA FAILURE - TROUBLESHOOT
			a.1. Perform EAU BUILT-IN-TEST. Replace EDU if test passes. Replace EAU if test fails.
			b. ### EDU TEST FAILURE - TROUBLESHOOT
			b.1. Perform EAU BUILT-IN-TEST. Replace EDU if test passes. Replace EAU if test fails.

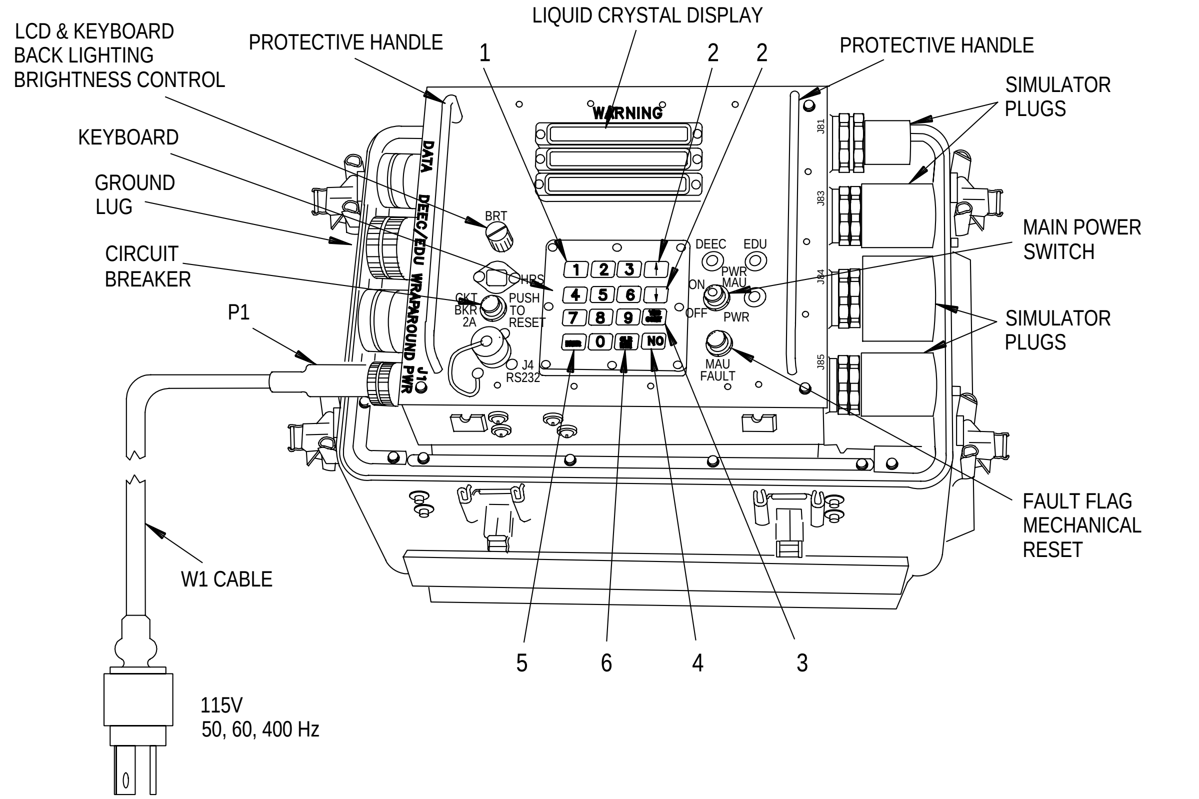
Table 1. EDU Test Procedure (continued)

Step	Procedure	Normal Indication	Other Indication/ Required Action
C.5.	Do not clear data at this time. Press NO button.	a. 1-DEEC TEST 2-EDU TEST 3-LOD TEST	
6.	Press CLR/RTN button	a. 1-BUILT-IN-TEST 2-REVIEW DATA 3-COMPONENT 4-REAL-TIME READ 5-MEMORY R/W 6-REMOVE MODE 7-DEEC/EDU CLEAR 8-DOC DATA 9-DATA TRANSFER	
D.	POSTTEST PROCEDURE		

CAUTION

To prevent damage to EAU, do not disconnect EAU from power source with EAU PWR switch on.

Step	Procedure	Normal Indication	Other Indication/ Required Action
1.	If no further testing is required, turn EAU PWR switch OFF. Turn OFF step-down transformer, if used.		
2.	If PWA 56032 is used, disconnect cables from engine, EAU, power source, and ground. Stow cables.		
3.	If EAU is not rack-mounted, install cover. Stow equipment.		



NUMBER	KEY	FUNCTION
1.	0 → 9	MENU SELECTION AND NUMERIC DATA ENTRY
2.	↑ ↓	LINE BY LINE SCROLLING
3.	YES/CONT	AFFIRMATIVE RESPONSE AND SEQUENCING FUNCTION
4.	NO	NEGATIVE RESPONSE
5.	ENTR	INITIATE PROCESSING OF MENU SELECTION OR DATA ENTRY
6.	CLR/RTN	CLEAR NUMERIC ENTRY AND RETURN TO PREVIOUS MENU

JN158 (37X2)

Figure 1. EAU Parts Identification: PWA 56032/PWA 56033 W1 Cable and EAU Power Cable Options (Sheet 1 of 2)

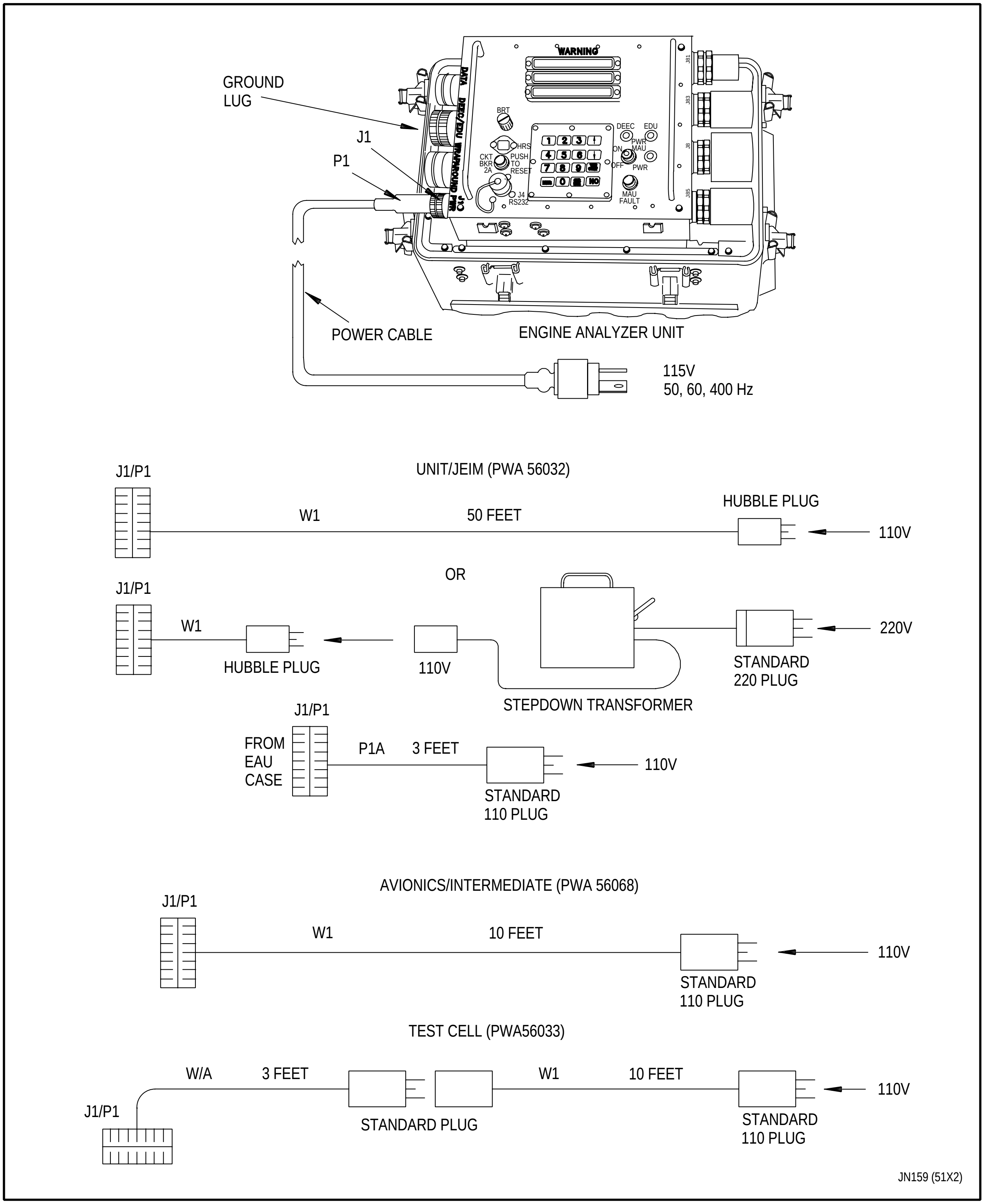


Figure 1. EAU Parts Identification: PWA 56032/PWA 56033 W1 Cable and EAU Power Cable Options (Sheet 2 of 2)

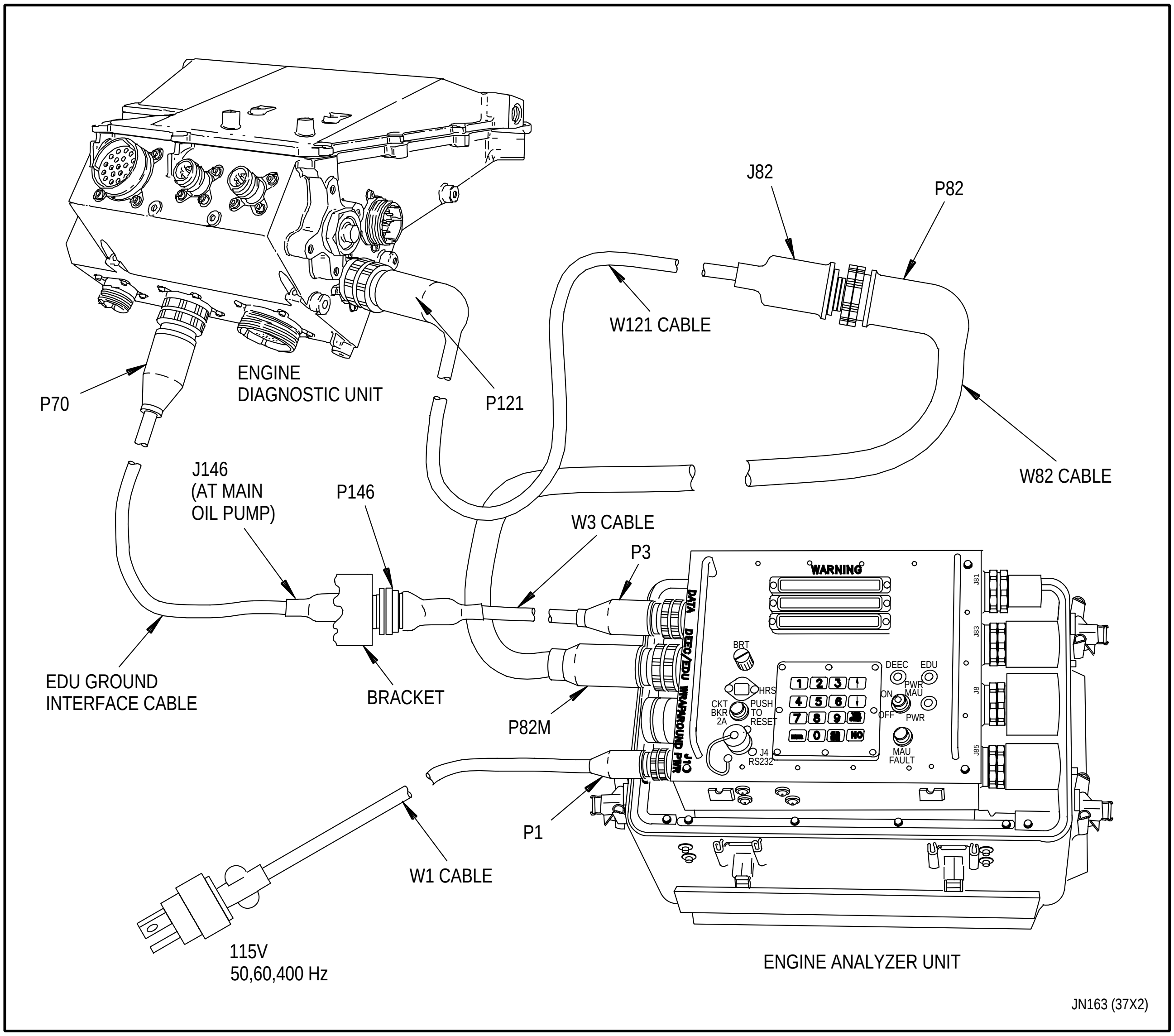


Figure 2. EDU and EAU PWA 56032/PWA 56033 Cable Set for EDU Functional Test

WORK PACKAGE

TECHNICAL PROCEDURES

DOWNLOADING AND REVIEWING DATA USING CEDS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 16

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Troubleshooting	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
CEDS Transfer Unit	T.O. 31S5-4-2142-2
Diagnostic System Interface Assembly	T.O. 33D4-6-745-2
Comprehensive Engine Diagnostic System (CEDS)	T.O. 33D4-6-746-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

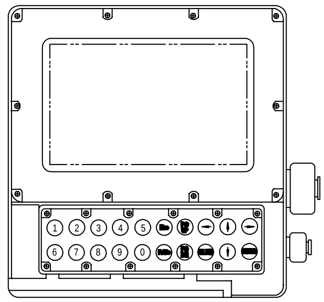
EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

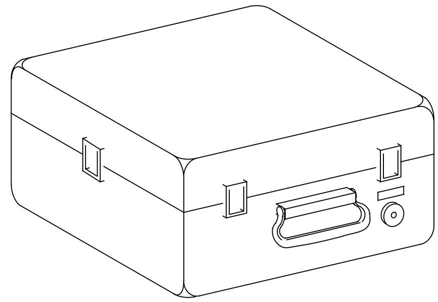
Paragraph	Function - Tool Nomenclature	Tool Number
	CEDS Software	PWA 56091
	Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114
	Floppy Disk Drive	Model/3401 or Equivalent
2	CEDS Set-Up	
3	EDU Download	
4	EMS Report Generator	
5	Examine EDU Memory	
6	Examine DEEC Memory	
7	Examine DEEC Faults	
8	Error Messages	
9	Post-Operation Procedures	

ILLUSTRATED SUPPORT EQUIPMENT



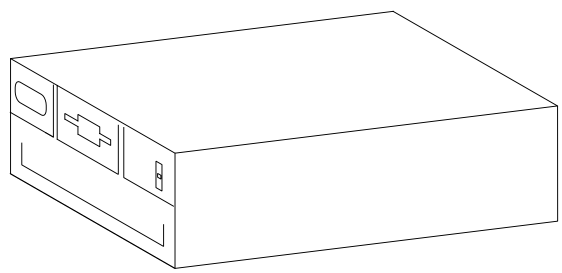
PWA 56102 –C

Figure T1. PWA 56102 Transfer Unit



PWA 56114 –C

Figure T2. PWA 56114 CEDS Interface Assembly



54347

Figure T3. Model/3401 Floppy Disk Drive

1. INTRODUCTION.

a. This work package contains procedures to download and review data using the Comprehensive Engine Diagnostic System (CEDS) (PWA 56091 software, PWA 56102 transfer unit, and PWA 56114 Diagnostic System Interface Assembly - DSIA).

b. These procedures are performed at the end of an engine test stand run, when a fault is indicated or a serially-tracked component is removed and replaced, or reinstalled.

c. EDU DOWNLOAD option allows data to be downloaded from EDU. A summary report of downloaded data is displayed on the screen and an option is provided to immediately proceed to the Report Generator for display of all data.

d. EMS REPORT GENERATOR function displays engine data in a variety of formats. Reports are generated using only the data stored in CEDS memory. Report generator contains the following formats:

(1) FLIGHT DATA REPORT - Listing of all data from a selected EDU download of a selected engine.

(2) CURRENT TIME/CYCLE REPORT - Scan of all time/cycle data.

(3) CURRENT INVENTORY REPORT - Listing of engines and related documentary data stored in CEDS memory.

(4) FAULT/EVENT OCCURRENCE REPORT - Listing of faults/ events on engines in CEDS memory.

(5) ENGINE SUMMARY REPORT - One-screen summary of all EDU downloads for a selected engine.

(6) PLOT DOWNLOAD TRANSIENT DATA - Ability to graphically plot transient data recorded by EDU.

e. EXAMINE DEEC FAULTS option is used to show all fault codes representing engine malfunctions.

f. EXAMINE EDU/DEEC MEMORY option is used to view EDU/DEEC EEPROM locations.

g. EDU may be cleared to prepare the engine for future operation. The EDU should not be cleared if faults or events are displayed on the download summary report. Troubleshoot faults/events before clearing EDU.

2. CEDS SET-UP.
(See Figures 1, 2, and 3.)

a. Figure 1. shows communication between elements of Engine Monitoring System (EMS).
Figure 2. shows CEDS Transfer Unit.
Figure 3. shows CEDS cable connections. Prepare CEDS for use. Refer to T.O. 33D4-6-746-1 and T.O. 31S5-4-2142-2.

CAUTION

To prevent erroneous operation, ensure J1, J77, J82, and J146 are connected through proper cables between engine and CEDS before attempting CEDS/EDU/DEC communications.

b. Turn Interconnection Module (ICM) POWER switch ON.

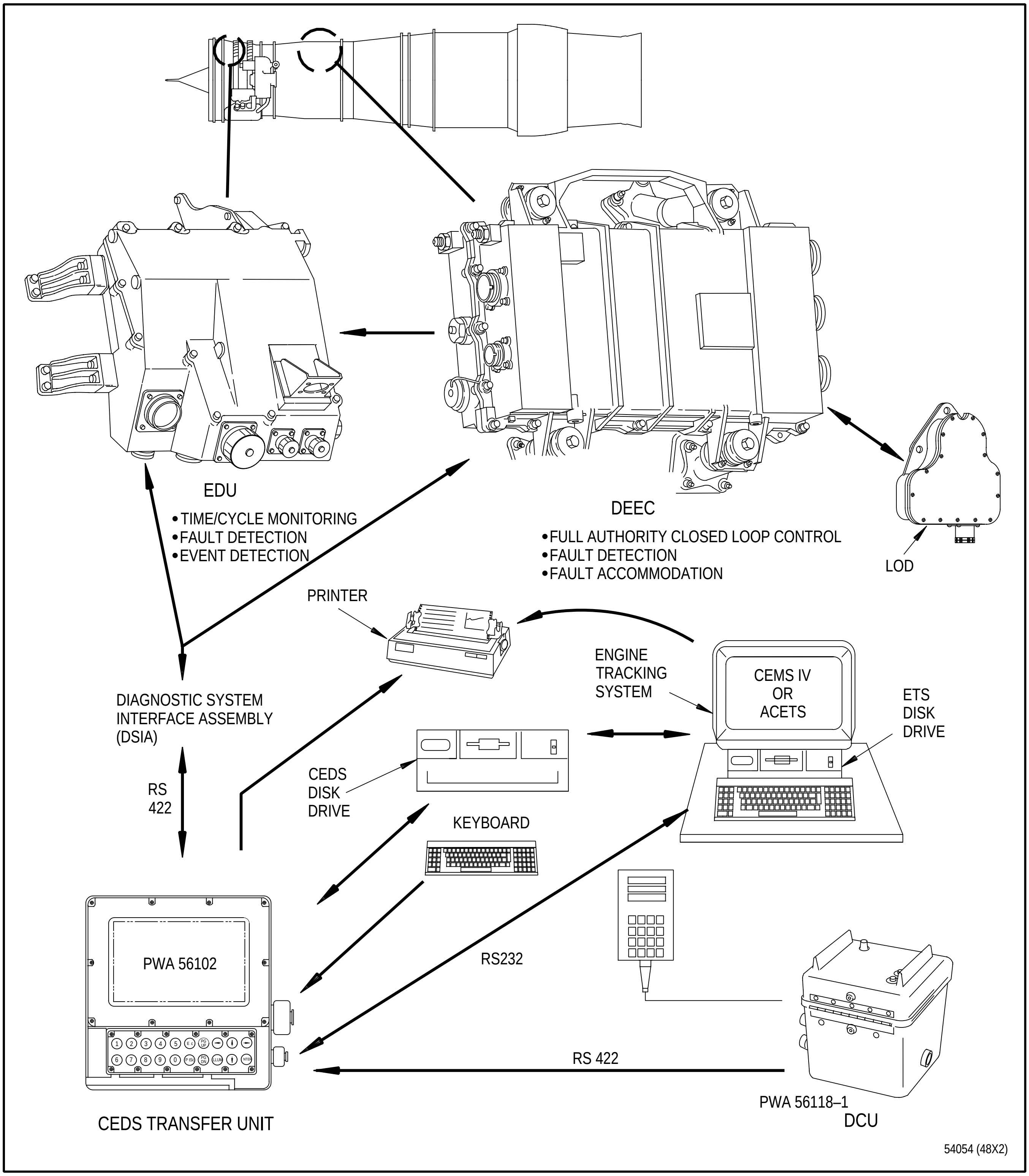


Figure 1. Engine Monitoring System

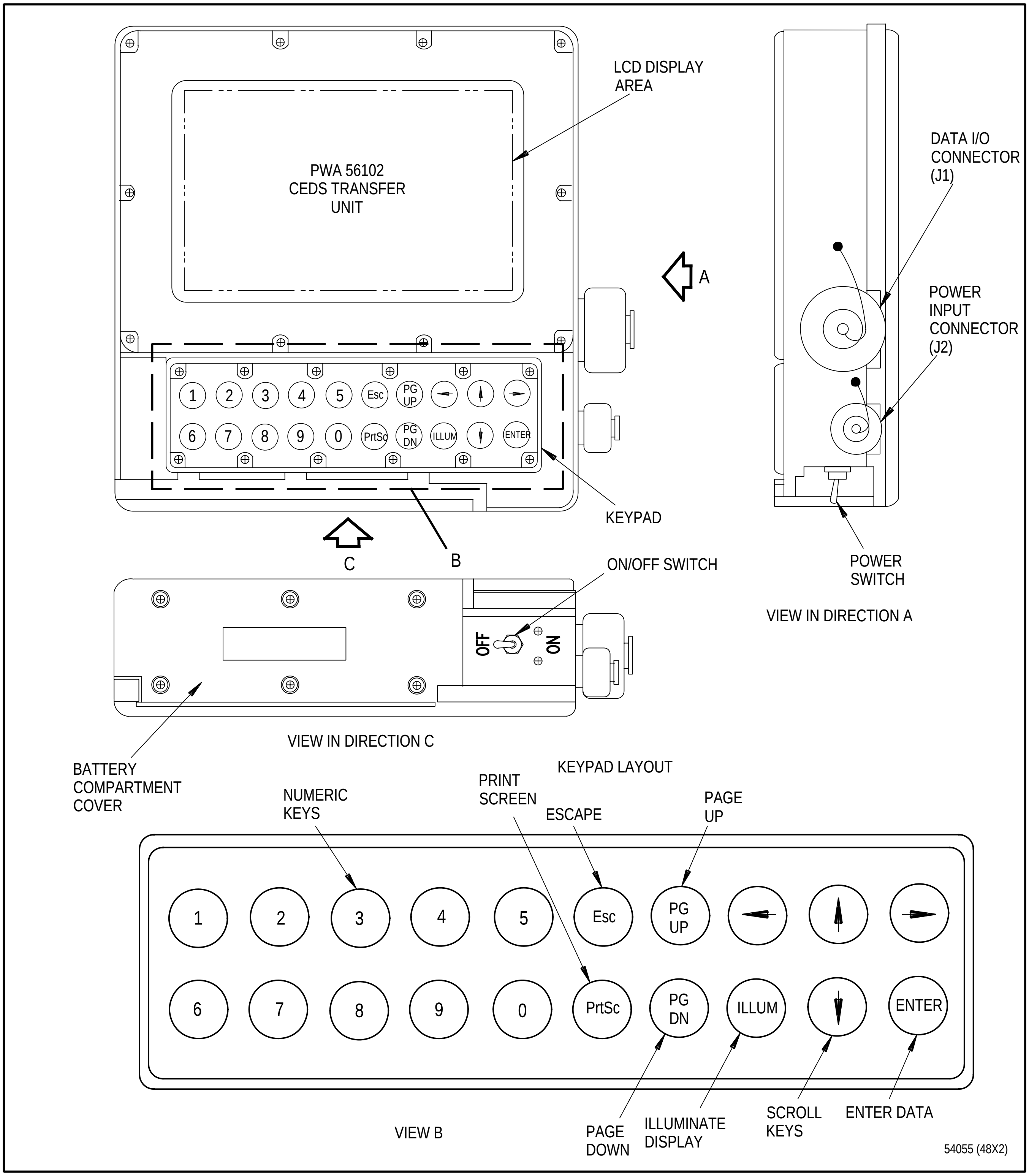


Figure 2. CEDS Transfer Unit

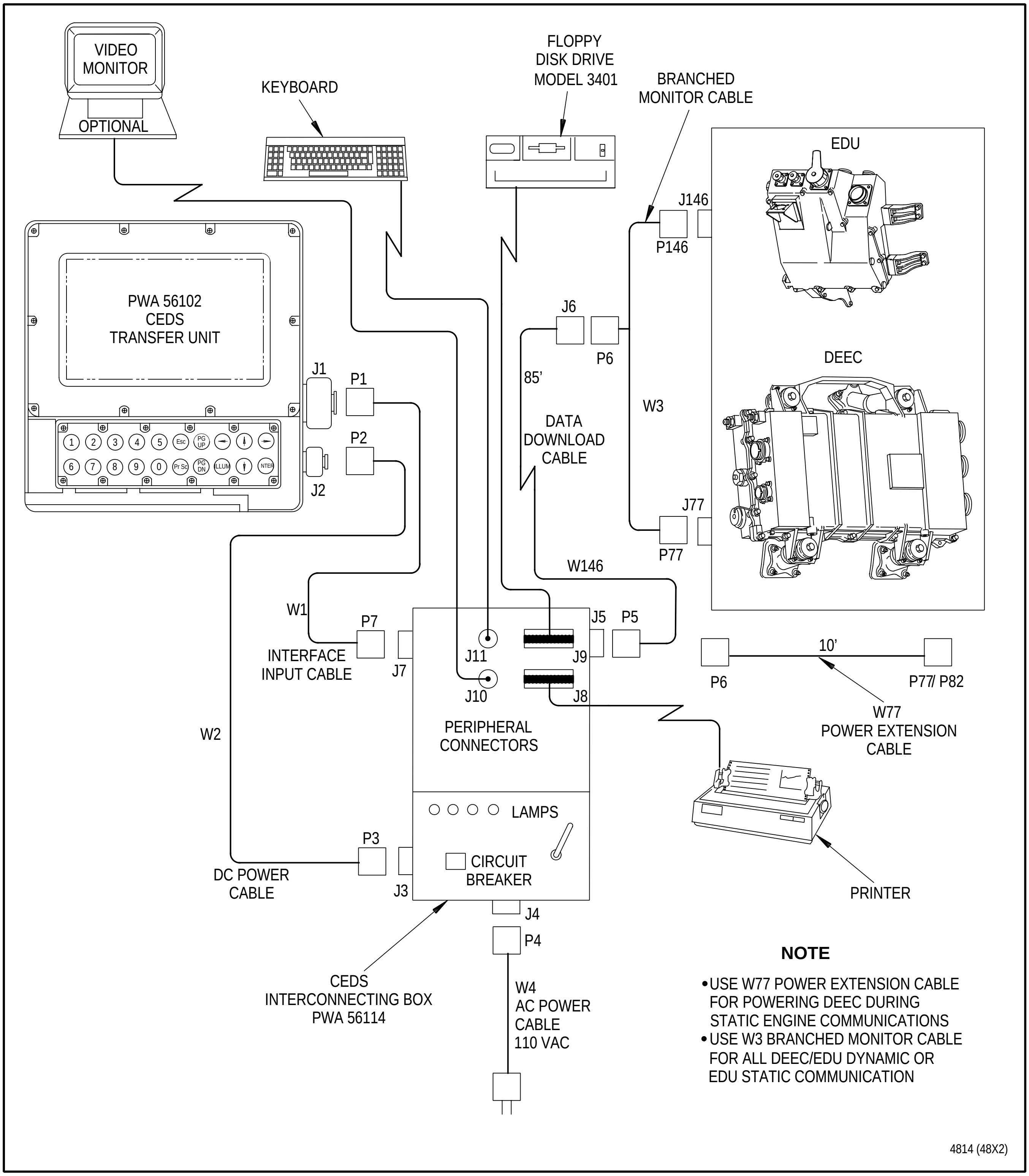


Figure 3. CEDS Communication Cable Connections

3. EDU DOWNLOAD.

(See figure 2, 3, and Figure 4.)

NOTE

- Before downloading ensure EDU power switch is in M37 test stand.
- Press escape (ESC) key at anytime to Main Menu (see figure 4.)
- CEDS can be shut off at any time provided CEDS Transfer Unit displays Main Menu.
- Press (PrtSc) key to print any screen.

a. Starting with CEDS MAIN MENU, Press (0, figure 4.) or select EDU COMMUNICATIONS then press ENTER.

b. Perform EDU DOWNLOAD as follows:

(1) Press (0) or select EDU DOWNLOAD and press ENTER.

(2) Ensure proper cable connections (see figures 2 and 3.) Press any key to download EDU.

NOTE

If there is duplicate engine data, download will not be stored in data base.

(3) EDU summary report will be displayed, press (0) to examine download data or any key to continue.

NOTE

If fault or events are displayed after downloading, do not clear EDU. Faults/Events are present and should be troubleshot before clearing EDU.

(4) Operator will be prompted to clear EDU by pressing (0) or any key to continue.

4. EMS REPORT GENERATOR.

(See figures 2, 3, and 4.)

NOTE

- Press escape (Esc) key at anytime to return to main menu.
- Press (PrtSc) key to print any screen.
- CEDS can be shut OFF at any time provided CEDS Transfer Unit displays Main Menu.

a. Starting with CEDS MAIN MENU, press (2, figure 4.) or select EMS REPORT GENERATOR and press ENTER.

(1) Perform FLIGHT DATA REPORT as follows:

(a) Press (0) or select FLIGHT DATA REPORT and press ENTER.

(b) Scroll through current engine inventory, select engine desired, press ENTER.

(c) Select engine run desired and press ENTER.

(d) Flight data report for selected engine will be displayed on screen. If any faults, events, advisory, performance, or transient data exists it will follow by pressing any key.

(2) Perform CURRENT TIME/CYCLE REPORT as follows:

(a) Press (1) or select CURRENT TIME/CYCLE REPORT and press ENTER.

(b) The Time/Cycle data review will be displayed with up to 5 engines per screen until all engines in CEDS memory have been displayed. Press any key to continue to next screen display. When there are no remaining engines on file, CEDS will return to EMS REPORT GENERATION menu.

(3) Perform CURRENT INVENTORY REPORT as follows:

(a) Press (2) or select CURRENT INVENTORY REPORT and press ENTER.

(b) The Inventory Summary will be displayed. Press any key to continue displaying all engines (maximum 60) in CEDS memory. Once all engines have been displayed, CEDS will return to EMS REPORT GENERATION menu.

(4) Perform FAULT/EVENT OCCURRENCE REPORT as follows:

(a) Press (3) or select FAULT/EVENT OCCURRENCE REPORT and press ENTER.

(b) Fault/Event Summary display will contain all faults or events in CEDS memory. They are sorted by lowest engine number and latest Date/Time. Press any key to continue displaying fault/event screens. Press (1) at any time to quit data examination.

(5) Perform ENGINE SUMMARY REPORT as follows:

(a) Press (4) or select ENGINE SUMMARY REPORT and press ENTER.

(b) Scroll through current engine inventory, select engine desired, press ENTER.

(c) Engine Summary Report display provides data for each engine S/N currently in CEDS memory. Display is sorted by latest Date/Time. Press any key to continue engine summary. After all screens have been displayed CEDS will return to current Engine Inventory display.

(6) Perform PLOT DOWNLOAD TRANSIENT DATA as follows:

(a) Press (5) or select PLOT DOWNLOAD DATA and press ENTER.

(b) Current EDU Download Transient Data display provides transient data sorted by engine number and latest Time/Date. Press (0) to page through downloads and arrows to select desired engine run. Once engine has been selected, press ENTER.

NOTE

User will be provided a display of transient data parameters. User may select one ‘‘x’’ parameter and up to 4 ‘‘y’’ parameters through cursor controlled selection process. There are no limitations placed upon which axis the parameter may be displayed. On the bottom of the screen is displayed a series of commands available to the operator. Some commands automatically initiate desired process, others require further operator input.

(c) Select X-Y parameters by using arrows to highlight parameter names, then press (0) for ‘‘X’’ parameters and (5) for ‘‘Y’’ parameters (maximum of 4). Parameters can be de-selected by pressing (0) or (5) key a second time.

NOTE

- Point Track (PT TRK) command places crosshairs on all plot lines. Crosshairs are placed in middle of graph with data values of each parameter displayed at top of screen. Crosshairs can be moved left and right to next data point on graph with arrow keys while value will be updated at the top.
- Fast Track (FASTRK) command is similar to ‘‘PT TRK’’ except that instead of tracking each point along graph, FASTRK skips along graph in increments of 1/20th the total number of scans recorded.
- Rescale Axes (RESCALE) is used to examine data more closely, the operator may change size of the data window. This command prompts operator to modify the minimum and maximum values for each selected parameter and then produce rescaled plot.
- Press (1) to quit data examination at any time.
- Press PRTSC to initiate screen dump of existing plot or data display if printer is connected and printout is desired.

(d) If STKPLT or OVLPLT were selected, you may select (2) point track or (3) fast track to examine data at a particular point, if you need to examine data more closely press (4) Rescale Axes. If TAB was selected go to next step.

(e) During TAB command you will be allowed to scroll either backward or forward throughout this table using up or down arrow keys.

(f) Return CEDS Transfer Unit to Main Menu.

(g) OVLPLT, or (4) TAB to examine data desired. Press PRTSC to initiate a screen dump of existing plot or data display.

NOTE

- Stack Plot (STKPLT) option allows up to four separate ''Y'' parameters plotted against ''X'' and ''stacked'' one on top of another. Selection of this option results in transient plots (TPLOTS) reading in appropriate data parameters, determine min/ max values and autoscale data for acceptable plot characteristics. Plots are labeled with engineering unit values, parameter names and identification title associated with the data record.
- Overlay Plot (OVLPLT) generated by this command is similar to those produced by STKPLT. The difference is that all ''Y'' parameters are overlayed on one graph using common ''Y'' axis scale with each line uniquely marked.
- Tabulate Transient Data (TAB) command produces table listing all transient data values recorded for the parameters selected.
- Escape (ESC) will cause termination of TPLOTS and returns operator control to the Main Menu.

(h) Select (2) STKPLT, (3) OVLPLT, or (4) TAB to examine data desired. Press PRTSC to initiate screen dump of existing plot or data display.

5. EXAMINE EDU MEMORY.
(See figures 1 through 4.)

NOTE

- Press escape (ESC) key at anytime to return to Main Menu.
- CEDS can be shut off at any time provided CEDS Transfer Unit displays the Main Menu.
- Press (PrtSc) key to print any screen.

a. Starting with CEDS MAIN MENU, press (0, figure 4.) or select EDU COMMUNICATIONS then press ENTER.

(1) Perform EXAMINE EDU MEMORY as follows:

(2) Ensure proper cable connections (See figures 2 and 3), press (4) or select EXAMINE EDU MEMORY.

NOTE

The Page Up (PgUP) key quits data examination while Page Down (PgDn) toggles between paging and scrolling.

(3) Scroll through memory using arrows or PAGE DOWN key.

(4) Enter memory address using function or numeric keys - locations are highlighted. Press ENTER to acknowledge memory examination input.

(5) Repeat steps 3 and 4 until all desired locations are examined.

(6) Press ESC key to return to Main Menu.

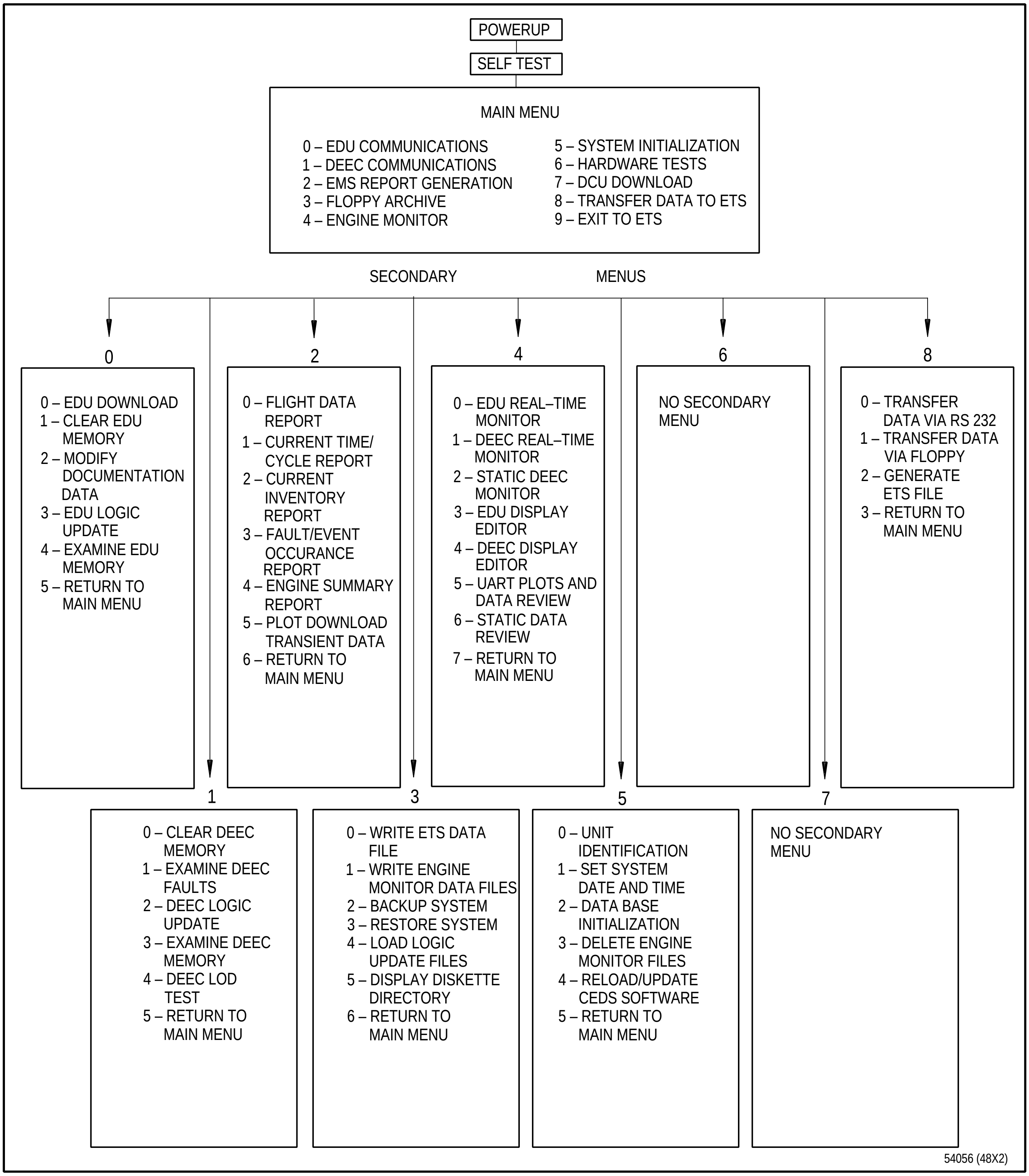


Figure 4. CEDS Operational Flow Chart

6. EXAMINE DEEC MEMORY.
(See figures 1 through 4.)

NOTE

- Press escape (ESC) key at anytime to return to Main Menu.
- CEDS can be shut off at any time provided CEDS Transfer Unit displays the Main Menu.
- Press (PrtSc) key to print any screen.

a. Starting with CEDS MAIN MENU, press (1, figure 4.) or select DEEC COMMUNICATIONS then press ENTER.

b. Perform EXAMINE DEEC MEMORY as follows:

(1) Press (3) or select EXAMINE DEEC MEMORY and press ENTER.

CAUTION

To prevent damage to CEDS and DEEC, do not start engine with W77 power extension cable installed.

(2) Ensure proper cable connections (See figures 2 and 3), press any key to Examine DEEC Memory.

NOTE

The (PgUp) key quits data examination while (PgDn) toggles between paging and scrolling.

(3) Scroll through memory using arrows or PAGE DOWN keys.

(4) Enter memory address using function or numeric keys, locations will be highlighted. Press ENTER to acknowledge memory examination input.

(5) Repeat steps 3 and 4 until all desired locations are examined.

(6) Press ESC key to return to Main Menu.

7. EXAMINE DEEC FAULTS.
(See figures 1 through 4.)

NOTE

- Press escape (ESC) key at anytime to return to Main Menu.
- CEDS can be shut OFF at any time provided CEDS Transfer Unit displays Main Menu.
- Press (PrtSc) key to print any screen.

a. Starting with CEDS MAIN MENU, press (1, figure 4.) or select DEEC COMMUNICATIONS and press ENTER.

(1) Press (1) or select EXAMINE DEEC FAULTS and press ENTER.

CAUTION

To prevent damage to CEDS and DEEC, do not start engine with W77 power extension cable installed.

(2) Ensure proper cable connections press any key to view DEEC faults.

(3) Press any key to continue viewing DEEC faults or (1) to quit examination.

(4) Press ESC key to return to Main Menu.

8. ERROR MESSAGES.
(See figures 1 through 4.)

NOTE

For the following six Communication Diagnostic ERROR messages, the first line gives an indication of the operation being performed and the second line will give Error number. Although the messages are worded differently, the corrective actions are all the same.

MESSAGES.	CORRECTIVE ACTION
The Communication Diagnostic ERROR messages are numbered as follows: 1-Timeout on block transfer 2-Block transmission error 3-No. ACK received from EDU/DEEC 4-No handshake with EDU/DEEC 5-Data written/received mismatch 6-SYNC words not found	• Record error message. • Perform Check on Transfer Unit battery/power supply and DSIA cables.Refer to T.O. 33D4-6-745-2. • Retry COMMUNICATIONS. • Perform Transfer Unit HARDWARE TESTS. Refer to T.O. 31S-5-4-2142-2. Replace Transfer Unit if test fails. • Replace DEEC/EDU.
Begin handshake with DCU Sending request for size command Sending request for data command Receiving DCU blocks... Transmission failed - errors detected! Press any key to continue...	• Check cable connections (W7 and W101). • Check DCU battery. • Try again (recycle DCU). • Perform Loop back check (EBIT). Refer to T.O. 31S-5-4-2142-2. Replace Transfer Unit if test fails.
Drive not ready (0) Abort, (1) Retry?	• Check floppy drive cable connections. • Check floppy disk drive to ensure diskette is properly inserted. • Retry • Replace floppy disk drive
No EDU update files exist! Press any key to continue...	• Update file has been deleted (more than 15 days). Reload files. • Retry disk or try new disk.

MESSAGE	CORRECTIVE ACTION
Performing file integrity checks... Update file integrity checks failed, process aborted! Press any key to continue...	• Reload logic update file.
Performing file integrity checks... EDU EEPROM ID more recent than attempted update, process aborted! Press any key to continue...	• Operator has tried to load an older revision than what the Transfer Unit has stored in memory. Check revision status and reload correct version.
Receiving UART, waiting for valid program identification	• Wait for proper engine N2 RPM (2000) and try again. • Possibility of a bad memory in EDU/ DEEC. Start engine, shut down and restart engine. Replace EDU/DEEC if required.
WARNING: Duplicate engine data, download not stored in data base! ENGSN : 740000 ACTN : 00-0000 EDUSM : BEDU0009 EDU ID : 5-020102 EDU EEPROM : 005 (Typical Data)	• This prevents CEMS IV from getting overloaded with previously stored data.
Unable to identify correct Fault Codes	• Invalid data is present in EDU fault counter Registers. • Perform EXAMINE DEEC FAULTS.

9. POST-OPERATION PROCEDURES.
(See figures 1 through 4.)

CAUTION

- To prevent possible damage to CEDS, EDU, and DEEC, do not disconnect cables from engine and CEDS J1, J77 or J82, and J146 during CEDS/EDU/DEEC communications.
- To prevent possible damage to transfer unit, ICM POWER switch must be turned OFF before disconnecting transfer unit from power source.

a. Press ESC key to return to MAIN MENU.

b. Turn ICM computer POWER switch OFF.

SUBORDINATE WORK PACKAGE

TECHNICAL PROCEDURES

DOWNLOADING AND REVIEWING DATA USING DTS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE SWP PAGES

Total Number of Pages in this SWP is 18

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 18	20				

REFERENCE MATERIAL REQUIRED

Title	Number
Operation and Maintenance Instructions With Illustrated Parts Breakdown (Data Transfer Set A/P24M-1(V)1) - - - -	T.O. 33D7-12-177-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
ALCOHOL, ISOPROPYL (PMC 9094)	TT-I-735
BRUSH, NONMETALLIC, SOFT	H-B-1490/3-T1

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	DTS SET-UP	
	DATA TRANSFER SET, A/P24M-1(V)1 - - - - - - - - - - - -	PN 92104800-10
5	REPORTS MENU PROCEDURES	
	DATA TRANSFER SET, A/P24M-1(V)1 - - - - - - - - - - - -	PN 92104800-10
	CEDS TRANSFER UNIT, MMU-167/P - - - - - - - - - - - - - -	PWA 56102

ILLUSTRATED SUPPORT EQUIPMENT

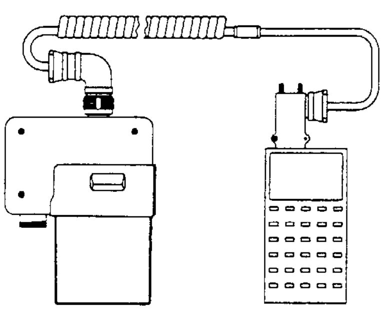


Figure T1. PN 92104800-10 DATA TRANSFER SET

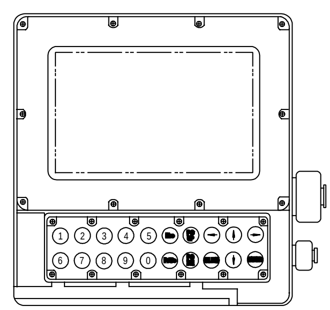


Figure T2. PWA 56102 CEDS TRANSFER UNIT

1. INTRODUCTION.

a. This subordinate work package contains procedures to download and review engine diagnostic data using Data Transfer Set (DTS).

2. DTS SET-UP.

(See Figure 1 and Table 1.)

a. Hardware familiarization is necessary since Data Transfer Set is designed for use on a variety of engine applications. Engine specific application software and download interface assemblies provide necessary customization required for individual users. The function of each DTS system component for individual applications is described in figure 1. Prior to use, DTS must be configured with appropriate software and download interface assembly.

b. DTS configuration: DTS assemblies and subassemblies are packaged for shipment and storage in the transport/storage case. The handset and interface adapter are contained within carrying case. All interface assemblies are included separately in transport/storage case.

c. Preparation for use:

NOTE

Electrical cables are referred to as interface assemblies.

(1) Core system assembly; refer to figure 1 for illustrations of system components. Assemble core DTS system as follows:

(a) Open transport/storage case.

(b) Inspect contents for shipping damage.

(c) Remove carrying case and inspect contents for damage.

(d) Disconnect handset interface assembly from J2 connector of interface adapter assembly and from COM1 of handset. Inspect for signs of wear and tear on wire near connector backshells.

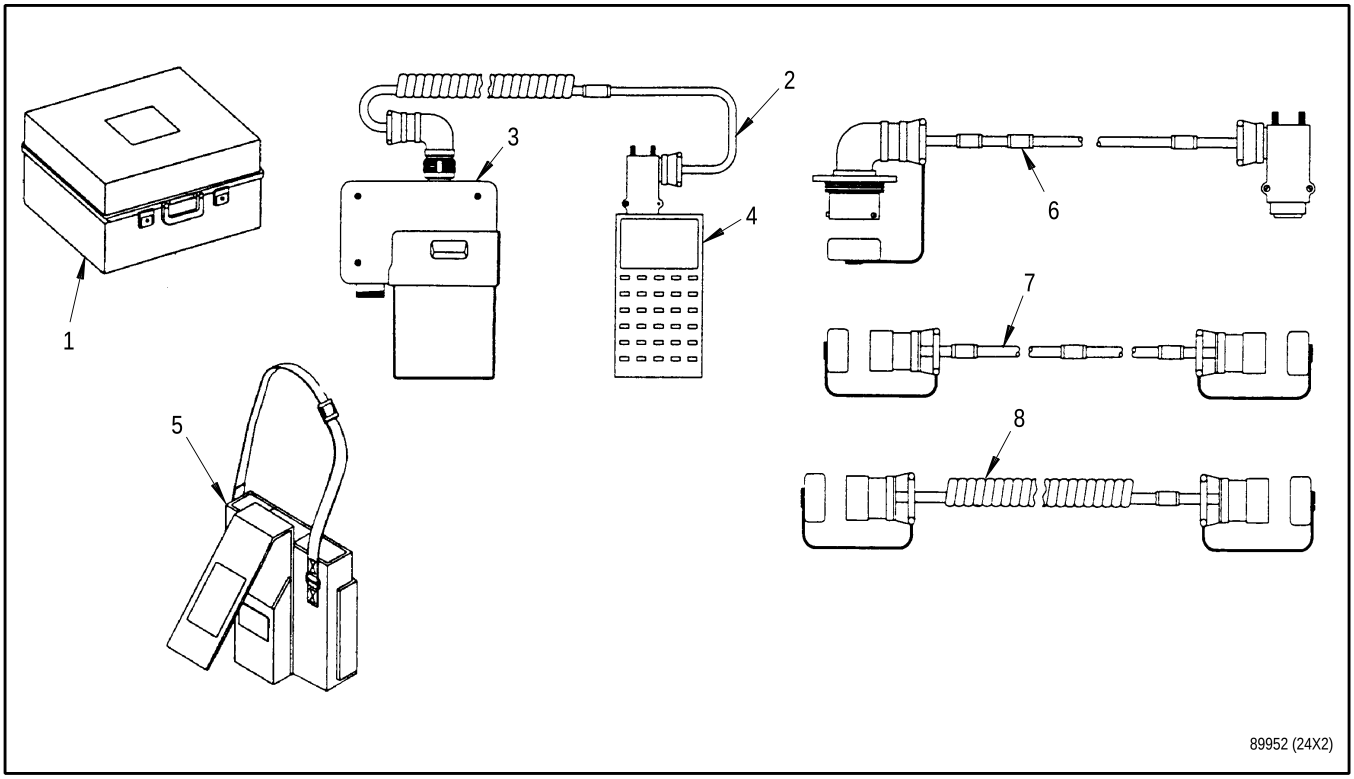
(e) Inspect all electrical connectors for oil or dirt contamination and bent or broken pins. If necessary, clean connectors using brush moistened with isopropyl alcohol and air dry.

NOTE

For instructions regarding battery serviceability and charging procedures refer to T.O. 33D7-12-177-1.

(f) Remove BB-557/U battery from storage area in transport/storage case and inspect for damage. Inspect electrical connector for damage. If necessary, clean connector using forced air. Ensure battery is charged and check for serviceability.

(g) Remove battery case assembly from interface adapter assembly and place BB-557/U in battery case assembly so battery connector is aligned with J3 connector on interface adapter assembly when battery case assembly is installed.



Item	Title	Part Number	Application
1.	Transport/storage case	92104803-10	Required for DTS storage and shipment
2.	Handset interface	92104808-10	Required for all DTS functions. Connects handset to interface adapter
3.	Interface adapter	92104809-10	Required for all DTS functions. Selects appropriate electrical interface and controls 24Vdc power to target device.
4.	Handset	92104801-10	Required for all DTS functions. Hosts DTS software.
5.	Carrying case	92104820-10	Required for all DTS functions. Houses and protects DTS assemblies during use, storage, and shipment.
6.	GSE interface	92104806-10	Required for DTS communication with ground station equipment, including CEMS IV.
7.	CEDS/DTS interface	92104807-10	Required for DTS communication with CEDS unit.
8.	F100-PW-229 download interface	92104805-10	Required for use on F100 engines. Provides necessary interface between DTS and EDU.

Figure 1. Data Transfer Set Assemblies

(h) Align detent on battery case assembly with recessed detent on enclosure case cover and slide the two pieces together. The detent in top of battery case will slip into place over enclosure case as BB-557/U battery connector mates with J3 connector on interface adapter.

(i) Install handset interface assembly connector P2 on handset COM1 RS-232 connector.

(j) Install handset interface assembly connector P1 on interface adapter connector J2.

(2) Configuration for jet engine intermediate use; after completing core system assembly per step c.(1), configure DTS for flightline use as follows:

(a) Select F100 download interface assembly cable.

(b) Inspect electrical connectors, interface assemblies and receptacles for oil or dirt contamination and bent or broken pins. If necessary, clean using brush moistened with isopropyl alcohol and air dry.

CAUTION

Failure to install connectors as specified may damage equipment.

(c) Install download interface assembly to J1 connector of interface adapter assembly. Ensure keyway is aligned and knurled ring handtightened until connector covers color band on receptacle.

(d) Place interface adapter assembly and download interface assembly into carrying case.

(e) Secure battery enclosure with velcro straps in carrying case.

(f) Close carrying case flap and align velcro surfaces for snug, smooth fit.

(3) Configuration for F100 ground station data transfer; after completing core system assembly per step c.(1), configure DTS for data transfer to F100 ground station as follows:

(a) Remove GSE interface assembly PN 92104806-10 from transport/storage case assembly.

(b) Inspect electrical connectors for oil or dirt contamination and bent or broken pins. If necessary, clean connectors using brush moistened with isopropyl alcohol and air dry.

(c) Disconnect P1 connector of handset interface assembly PN 92104808-10 from J2 connector of interface adapter assembly.

CAUTION

Failure to install connectors as specified may damage equipment.

(d) Connect P1 connector of handset interface assembly to J1 connector of GSE interface assembly. Ensure keyway is aligned and knurled ring handtightened until connector covers color band on receptacle.

(e) Connect P2 connector of GSE interface assembly on COM1 port of F100 ground station computer.

(4) Configuration for CEDS data transfer; after completing core system assembly per step c.(1), configure DTS for data transfer to CEDS as follows:

(a) Remove CEDS/DTS interface assembly PN 92104807-10 from transport/storage case.

(b) Inspect electrical connectors for oil or dirt contamination and bent or broken pins. If necessary, clean connectors using brush moistened with isopropyl alcohol.

CAUTION

Failure to install connectors as specified may damage equipment.

NOTE

Connectors on CEDS/DTS interface assembly are interchangeable. Either end may be connected to J1 connector on interface adapter assembly.

(c) Install CEDS/DTS interface assembly to J1 connector of interface adapter assembly. Ensure keyway is aligned and knurled ring handtightened until connector covers color band on receptacle.

(d) It is not necessary to secure interface adapter assembly inside carrying case unless this configuration is to be exposed to handling in the flightline environment.

d. Software installation onto handset, PN 92104801-10, if required, is performed by following procedures specified in T.O. 33D7-12-177-1. Refer to table 1 for applicable Computer Program Identification Number (CPIN) assignment for DTS.

Table 1. DTS Software

CPIN	Application
81E-F100/ DTS-F001-00A	Enable DTS operation for F100 engine downloads

3. MENU DESCRIPTIONS.
(See Figure 2 and Table 2.)

a. The menu descriptions used when performing data downloading and reviewing are in table 2 and figure 2.

Table 2. Menu Descriptions

Main Menu Selection	Secondary Menu Selection	Function
EDU	EDU DOWNLOAD	Performs EDU data download: A summary report of downloaded data is displayed and an option to immediately proceed to Report Generator is provided. Operator is asked whether or not to clear EDU memory after download.
	CLEAR EDU	Clears EDU memory: Option to clear EDU is also available after exercising EDU DOWNLOAD selection. Fault/Event codes must be preserved for engine troubleshooting. However, EDU should be cleared before next engine run. This procedure is used to clear EDU after troubleshooting is complete. The CLEAR EDU option only erases data stored in data pointers. The actual engine data is not erased but can be overwritten during subsequent engine operation. Pointers identify valid data. DTS will only display valid data.
	MODIFY DOC DATA	Modifies aircraft tail number, engine serial number, EDU serial number and STP flag. To store new DOC Data in DTS memory, operator must download EDU after DOC Data modification.
	EXAMINE MEMORY	Retrieves and displays EDU memory locations.
	RETURN	Returns program control to Main Memory. The ESC key performs same function.
REPORTS	FLIGHT REPORT	Sorts engine data and displays data by engine serial number.
	TIME/CYCLE	Displays time/cycle data for each engine stored.
	INVENTORY	List engine serial numbers and corresponding A/C tail numbers, EDU serial number, EDU ID, and DEEC ID.
	FAULT/EVENT	Displays faults, events, and advisories on engines in DTS memory.
	ENGINE SUMMARY	Allows operator to view all stored downloads for a selected engine.
	RETURN	Returns program control to Main Memory. The ESC key performs same function.

Table 2. Menu Descriptions (continued)

Main Menu Selection	Secondary Menu Selection	Function
INITIAL-IZATION	UNIT ID	Allows user to assign unit identification using keypad.
	SET DATE/TIME	Allows user to set system date and time from keyboard. Correct date/time is essential for proper sequencing in Engine Tracking System (ETS).
	CLEAR DATABASE	Allows user to reinitialize DTS databases. All engine data shall be transferred to ETS or CEDS before using CLEAR DATABASE function, as all engine data will be deleted.
	BATTERY POWER	Allows user to check status of interface adapter battery.
	RETURN	Returns program control to Main Memory. The escape ESC key performs same function.
TRANSFER DATA	TRANSFER TO ETS	Transfers data to Engine Tracking System (ETS): DTS creates an ETS file (CED2CEMS.DAT) and transfers file to ETS via RS-232. The ETS may be CEMS IV or ACETS. Data transfer software shall be activated in ETS computer before transfer can be performed. DTS deletes CED2CEMS.DAT in its memory after data transfer is complete.
	TRANSFER TO CEDS	Transfers data to CEDS: DTS prompts operator to make connections and initiates an EDU Download form CEDS. Downloads stored in DTS are transferred to CEDS one at a time. DTS erases each download from DTS memory after successful transfer.
	GENERATE ETS FILE	Allows user to recreate ETS file after transfer to ETS.
	RETURN	Returns program control to Main Memory. The ESC key performs same function.
EXIT	NO SECONDARY MENU	Allows user to exit DTS menus and return to Handset operating system.

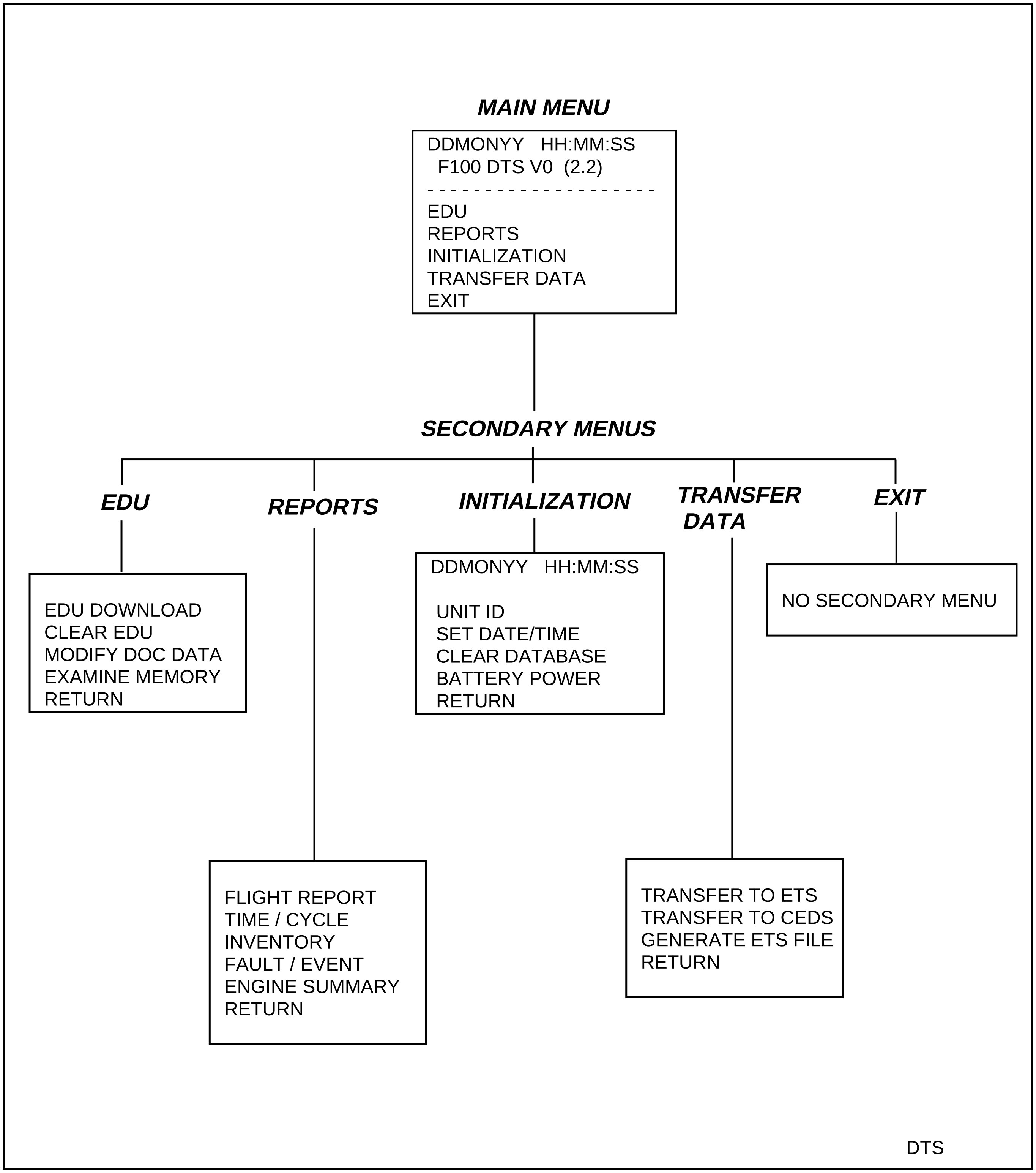


Figure 2. Data Transfer Set (DTS) Menu Tree

4. EDU MENU PROCEDURES.

(See figure 2 and Figures 3 and 4, and table 2.)

NOTE

- DTS uses a menu driven operational format. DTS operator will be prompted by menu options and commands on DTS screen.
- Pressing escape ESC key returns operation to main menu.
- EDU menu procedures include EDU Download, EDU Clear, Modify Doc Data and Examine Memory options.

a. Ensure EDU power switch is OFF in M37 test stand before performing EDU menu procedures.

b. Ensure proper cable connections per figures 3 and 4.

c. Starting with DTS main menu, per figure 2 and table 2, use arrow keys to highlight EDU and press ENTER, SECONDARY menu should appear.

d. Using arrow keys, highlight desired function on secondary menu.

e. Press ENTER and follow instructions on screen.

f. Press ESC to return to main menu when function is complete.

5. REPORTS MENU PROCEDURES.

(See figure 2 and table 2.)

NOTE

- DTS uses a menu driven operational format. DTS operator will be prompted by menu options and commands on DTS screen.
- Pressing escape ESC key returns operation to main menu.
- REPORTS menu procedures include Flight Report, Time/Cycle, Inventory, Fault/Event and Engine Summary options.

a. Starting with DTS main menu, per figure 2 and table 2, use arrow keys to highlight REPORTS and press ENTER.

(1) Perform FLIGHT REPORT as follows:

(a) Select FLIGHT REPORT option and press ENTER.

(b) A brief message "Sorting engine data base" will be displayed, followed by a summary of engine serial numbers contained in DTS memory.

(c) Select engine serial number to display, and press any numeric for flight report information.

(d) Follow operator prompts on DTS to display data. If option to quit is not executed, data will be displayed page by page until all information has been presented.

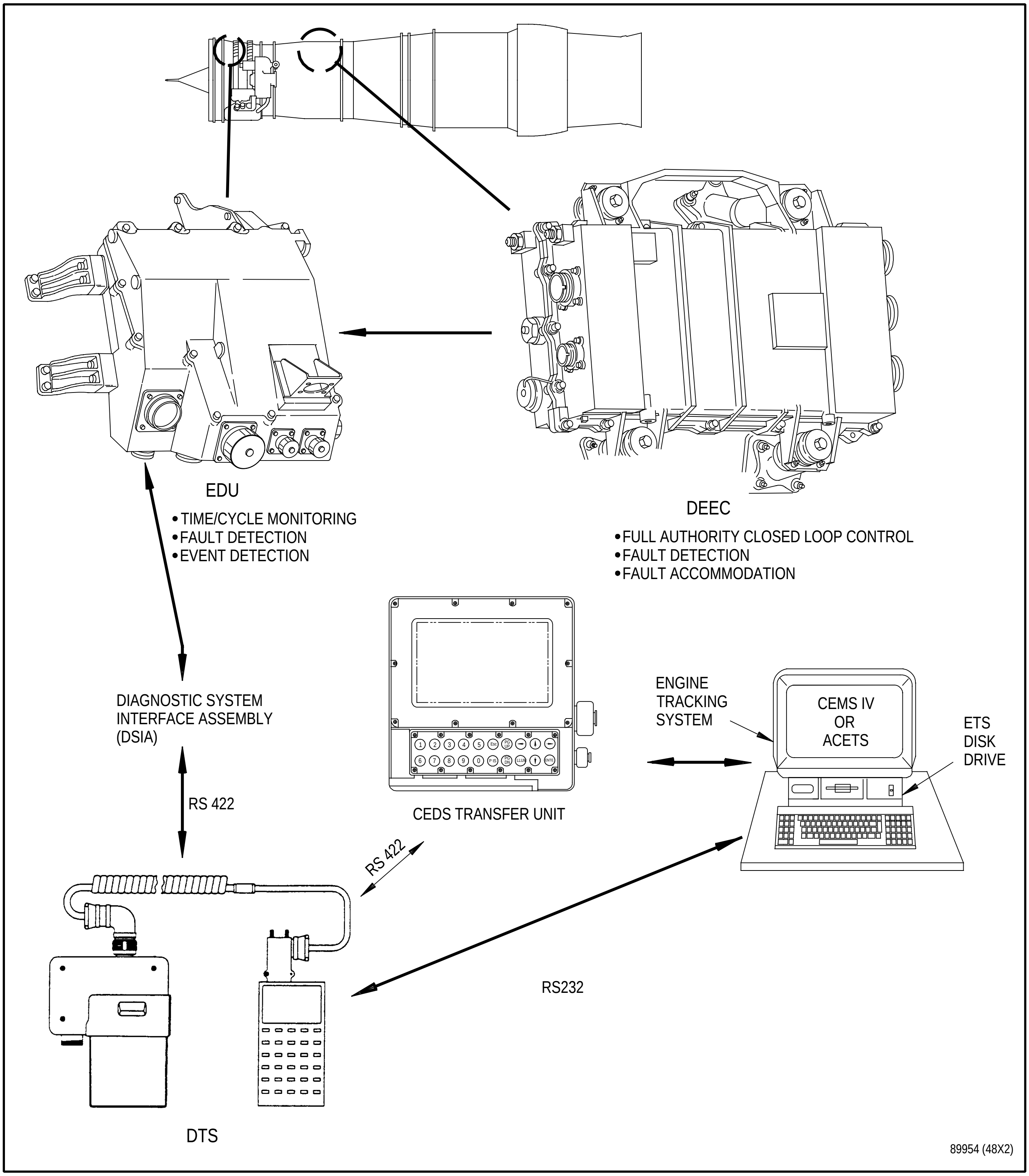


Figure 3. Engine Monitoring System.

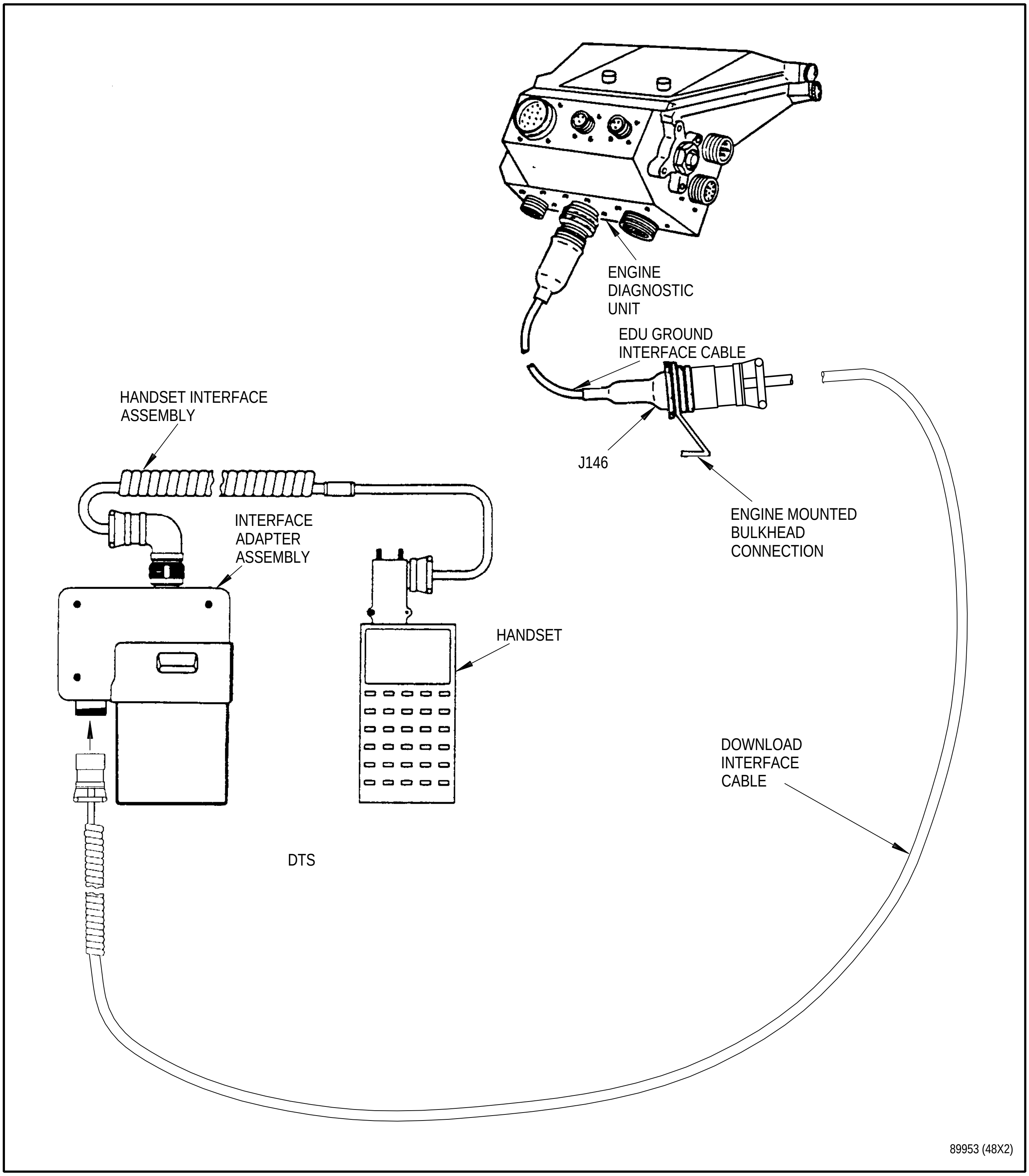


Figure 4. DTS/EDU Connection.

(2) Perform TIME/CYCLE REPORT DISPLAY as follows:

(a) Select TIME/CYCLE option and press ENTER.

(b) Follow DTS screen prompts to display data. If option to quit is not executed, data will be displayed page by page until all information has been presented.

(3) Perform INVENTORY REPORT DISPLAY as follows:

(a) Select INVENTORY option and press ENTER.

(b) A brief message "Sorting engine data base" will be displayed, followed by a summary of engine serial numbers contained in DTS memory.

(c) Follow DTS screen prompts to display data. If option to quit is not executed, data will be displayed page by page until all information has been presented.

(4) Perform FAULT/EVENT REPORT DISPLAY as follows:

(a) Select FAULT/EVENT option and press ENTER.

(b) A brief message "Sorting engine data base" will be displayed, followed by a summary of engine serial numbers contained in DTS memory.

(c) Follow DTS screen prompts to display data. If option to quit is not executed, data will be displayed page by page until all information has been presented.

(5) Perform ENGINE SUMMARY REPORT DISPLAY as follows:

(a) Select ENGINE SUMMARY option and press ENTER.

(b) A brief message "Sorting engine data base" will be displayed, followed by a summary of engine serial numbers contained in DTS memory.

(c) Select engine serial number for further data display and press any numeric to proceed.

(d) Follow DTS screen prompts to display data. If option to quit is not executed, data will be displayed page by page until all information has been presented.

6. INITIALIZATION MENUS.
(See figure 2 and table 2.)

NOTE

- DTS uses a menu driven operational format. DTS operator will be prompted by menu options and commands on DTS screen.
- Pressing escape ESC key returns operation to main menu.
- INITIALIZATION procedures include Unit ID, Set Data and Time, Clear Database and Battery Power.

a. Starting with DTS main menu, per figure 2 and table 2, use arrow keys to highlight INITIALIZATION and press ENTER.

(1) Perform UNIT ID as follows:

(a) Select UNIT ID option and press ENTER.

(b) Screen display will appear as follows:

```
Type identification
then <Enter>
Current id:  xxxxxx
<<Op ID>>
=>_-------------
```

(c) Type desired unit ID. Do not exceed allowed number of characters as indicated by "-" on DTS screen.

(d) Use left arrow key to backspace and delete typed data as necessary.

(e) Press ENTER to accept Unit ID displayed.

(2) Perform SET DATE/TIME as follows:

(a) Select SET DATE/TIME option and press ENTER.

(b) Type two digit number for month, followed by a decimal ".".

(c) Type two digit number for day, followed by a decimal ".".

(d) Type two digit number for year. DO NOT PRESS ENTER. DTS software will store date when last digit of year is entered and will automatically present Set Time option.

(e) Type two digit number for hours, followed by a decimal ".".

(f) Type two digit number for minutes. DO NOT PRESS ENTER.

(g) Updated system date and time will be displayed at top of INITIALIZATION submenu.

(h) Select RETURN option to return to DTS main menu and press ENTER.

(3) Perform CLEAR DATABASE as follows:

(a) Select CLEAR DATABASE option and press ENTER.

(b) Press any numeric key to confirm clear database selection when prompted by operator message. If a non-numeric key is pressed, INITIALIZATION submenu will redisplay.

(4) Perform BATTERY POWER procedures as follows:

(a) Select BATTERY POWER option and press ENTER

(b) The BB-557/U battery level will be displayed on a battery gauge. The voltage level shown as a percentage of usable battery level will be displayed under the battery gauge.

(c) Press any key to return to INITIALIZATION menu.

7. TRANSFER DATA MENUS.
(See figure 2 and table 2.)

NOTE

- DTS uses a menu driven operational format. DTS operator will be prompted by menu options and commands on DTS screen.
- Pressing escape ESC key returns operation to main menu.
- TRANSFER DATA procedures include transfer to ETS, transfer to CEDS and Generate ETS file.

a. Starting with DTS main menu, per figure 2 and table 2, use arrow keys to highlight TRANSFER DATA and press ENTER.

(1) Perform TRANSFER TO ETS as follows:

(a) Configure DTS per paragraph 2.c.(3) for F100 ground station data transfer.

(b) Ensure receiving computer is ready for file transfer.

(c) Ensure GSE interface assembly is connected between handset interface assembly and COM1 of receiving computer.

(d) Select TRANSFER TO ETS option and press ENTER. Wait for transfer to complete as noted by messages displayed on receiving computer and DTS handset.

(2) Perform TRANSFER TO CEDS as follows:

(a) Configure DTS per paragraph 2.c.(4) for CEDS data transfer.

(b) Connect CEDS/DTS interface assembly to CEDS J1 connector.

(c) Position CEDS ON/OFF switch to ON.

(d) Select TRANSFER TO CEDS option on DTS and press ENTER.

(e) Press any numeric key to proceed when prompted.

NOTE

DTS "TRANSFER TO CEDS" will abort with a timeout if CEDS "EDU DOWNLOAD" option is not selected and executed within 15 seconds of step a.(2)(e). If this occurs, steps a.(2)(d) and (e) shall be repeated.

(f) Select EDU DOWNLOAD option from CEDS and press ENTER. DTS is substituting as EDU during this procedure.

(g) Follow operator prompts displayed by CEDS to perform download.

NOTE

Downloads will be transferred from DTS to CEDS one at a time by repeating step a.(2)(g) until DTS displays "NO MORE DATA TO TRANSFER".

(h) Repeat steps a.(2)(f) and (g) until DTS displays "NO MORE DATA TO TRANSFER".

8. ANOMALIES AND CORRECTIVE ACTIONS.

(See Table 3.)

a. Perform troubleshooting per table 3.

Table 3. Anomalies and Corrective Actions

Anomaly	Probable Cause	Corrective Action
Handset fails to power ON.	Low internal batteries	Recharge handset internal batteries or replace internal batteries. Refer to T.O. 33D7-12-117-1.
Handset fails to power ON after charging	Handset reset required	Reset handset and if necessary, replace internal batteries. Refer to T.O. 33D7-12-117-1.
Failure in communication with interface adapter assembly	Improper conncection between BB-557/U battery and interface adapter	Check BB-557/U battery installation. Refer to T.O. 33D7-12-117-1.
	Low BB-557/U battery	Inspect interface adapter diagnostics. Refer to T.O. 33D7-12-117-1.
	Defective handset interface assembly (PN 92104808-10/-30	Inspect handset interface assembly for bent/broken pins. Perform continuity check. Refer to T.O. 33D7-12-117-1. Refer to T.O. 1-1A-15 (General Maintenance Instructions for Support Equipment) to perform repairs.
	Blown fuse on control board assembly PN 92104810-10 in interface adapter PN 92104809-10	Open interface adapter and check fuse on control board. Replace if defective. Refer to T.O. 33D7-12-117-1.
	Defective enclosure internal wired assembly PN 92104811-10	Open interface adapter and inspect enclosure internal wired assembly for bent/broken pins. Perform continuity check. Refer to T.O. 33D7-12-117-1. Refer to T.O. 1-1A-15 to perform repairs.

Table 3. Anomalies and Corrective Actions (continued)

Anomaly	Probable Cause	Corrective Action
Failure in communication with interface adapter assembly (continued)	Defective control board	Remove and replace control board assembly. Refer to T.O. 33D7-12-117-1.
	Defective COM port on handset PN 92104801-10	Replace handset and forward to repair facility.
EDU communication	Low BB-557/U NiCd battery	Ensure BB-557/U battery voltage is greater than 20Vdc.
	Defective download interface assembly PN 92104805-10/-30	Inspect download interface assembly for bent/broken pins. Perform continuity check. Refer to T.O. 33D7-12-117-1. Refer to T.O. 1-1A-15 to perform repairs.
	Defective interface adapter assembly	Perform interface adapter diagnostic checks. Refer to T.O. 33D7-12-117-1.
	Defective EDU	Repeat EDU communication using CEDS. Replace EDU if communication repeats. Otherwise, replace DTS.
GSE communication	Defective GSE interface assembly PN 92104806	Inspect GSE interface assembly for bent/broken pins. Perform continuity checks. Refer to T.O. 33D7-12-117-1. Refer to T.O. 1-1A-15 to perform repairs.
	Defective interface adapter assembly	Perform interface adapter diagnostic checks. Refer to T.O. 33D7-12-117-1.
	Defective GSE COM port	Attempt GSE communication with CEDS. Replace GSE computer if communication anomaly continues, otherwise, replace DTS.
CEDS communication	Defective CEDS/DTS inteface assembly PN 92104807	Inspect CEDS/DTS interface assembly for bent/broken pins. Perform continuity check. Refer to T.O. 33D7-12-117-1.
	Defective interface adapter assembly	Perform interface adapter diagnostics. Refer to T.O. 33D7-12-117-1.
	Defective CEDS COM port	Perform CEDS COM port diagnostic check. Refer to T.O. 33D7-12-117-1 and T.O. 33D4-6-746-1.
Duplicate engine data, download not stored in database!	Download already exists in DTS database	None. This prevents ETS from getting overloaded with previously stored data.

9. POST OPERATION PROCEDURES.

CAUTION

Disconnecting cables during data downloading may damage DTS and peripherals.

a. Press escape ESC key or highlight RETURN menu option and press ENTER to return to main menu. Do not disconnect cables during data downloading.

b. Turn off power to DTS handset using DTS power key.

WORK PACKAGE

TECHNICAL PROCEDURES

DEEC TEST PROCEDURES USING EAU

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 14

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 13	0				
14 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting General	WP 501 00
EAU Built-In-Test	WP 654 00
Engine Analyzer Unit - Operation Instructions (This unit is designated as a jet engine analyzer unit in referenced technical manual.)	T.O. 33D4-6-684-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

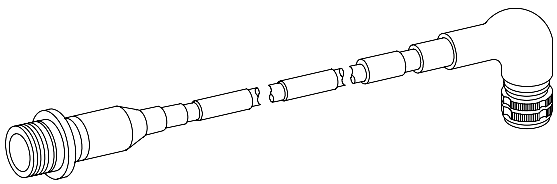
EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

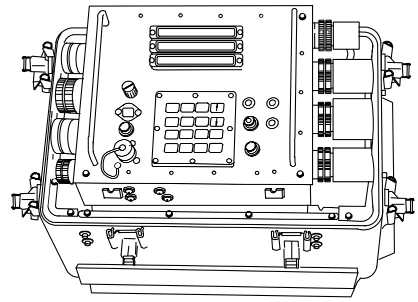
Paragraph	Function - Tool Nomenclature	Tool Number
2	DEEC Test Procedure Using EAU	
	Interface cables	PWA 56032 PWA 56033
	Engine analyzer unit	PWA 56084

ILLUSTRATED SUPPORT EQUIPMENT



PWA 56033 –C

Figure T1. PWA 56032/PWA 56033 Interface Cable (Typical)



PWA 56016 –C

Figure T2. PWA 56084 Engine Analyzer Unit

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for DEEC test using PWA 56032 and PWA 56033 interface cables, and PWA 56084 EAU.

b. These procedures are DEEC functional checks used to eliminate DEEC as cause of faults. DEEC tests performed by EAU require removing all connectors from DEEC and replacing then connectors with simulator plugs. The plugs will wrap output signals around and into input channels. When DEEC test is selected, the EAU powers the DEEC through its automatic self-test. The EAU then uploads a small exercise for the DEEC to force the DEEC to check its input and output channels. This exercise gives the DEEC more than 95% self-test capability.

2. DEEC TEST PROCEDURE USING EAU.

(See Figures 1 and 2, and Table 1.)

a. Perform DEEC test procedure using PWA 56084 EAU per table 1.

Table 1. DEEC Test Procedure

Step	Procedure	Normal Indication	Other Indication/Required Action
A.	EAU SET-UP (See figure 1.)		
1.	Remove EAU cover.		

WARNING

To prevent injury to personnel or damage to EAU, ensure EAU is properly grounded before applying electrical power.

Step	Procedure	Normal Indication	Other Indication/Required Action
2.	Properly ground EAU.		

CAUTION

Ensure EAU PWR switch is OFF before connecting or disconnecting electrical power.

Step	Procedure	Normal Indication	Other Indication/Required Action
3.	Turn EAU PWR switch OFF.		

CAUTION

- PWA 56032 cable set case step-down transformer shall be used if EAU power source is 220 Vac. Failure to use transformer may damage EAU, even with EAU PWR switch OFF.
- Do not use transformer if EAU power supply is 110 to 125 Vac. Use of step-down transformer with 110 Vac power source will cause erroneous EAU operation and may damage EAU.

Step	Procedure	Normal Indication	Other Indication/Required Action
4.	Connect W1 power cable to EAU J1 connector. See figure 1.		
5.	Ensure power supply is 110 to 125 Vac.	a. Voltage and frequency within limits	a. Go to step 6.
		b. Voltage and frequency out of limits.	b. Repair or replace power source.

Table 1. DEEC Test Procedure (continued)

Step	Procedure	Normal Indication	Other Indication/Required Action
A.6.	Plug W1 cable into power supply.		
6.a.	If step-down transformer is used, plug W1 cable into Hubble plug of transformer.		
6.b.	Turn transformer power switch OFF.		
6.c.	Connect transformer to 220 Vac power supply.		

CAUTION

Loss of engine driven electrical power due to fuel starvation may cause a destructive current surge through the EAU. Ensure an adequate fuel supply before starting.

Step	Procedure	Normal Indication	Other Indication/Required Action
6.d.	Turn transformer ON.		
B.	EAU SELF TESTS		
1.	Turn EAU PWR switch ON.	a. EAU SELF-TEST IN PROGRESS-WAIT	
		EAU SELF-TEST PASSED EAU ID 1-020100	a. EAU SELF-TEST FAILURE xxxx test a.1. Replace EAU.
2.	Press YES/CONT button.	a. INDICATE EAU LOCATION 1-FLIGHT LINE	
		2-TEST CELL 3-BENCH TEST	

Table 1. DEEC Test Procedure (continued)

Step	Procedure	Normal Indication	Other Indication/Required Action
B. 3.	Determine cable set in use: PWA 56032 - Flight Line PWA 56033 - Test Cell Press corresponding number and ENTR buttons.	a. # -xxxx xxxx 1-BUILT-IN-TEST 2-REVIEW DATA 3-COMPONENT TEST 4-REAL TIME READ 5-MEMORY R/W 6-REMOTE MODE 7-DEEC/EDU CLEAR 8-DOC DATA 9-DATA TRANSFER	
C.	DEEC FUNCTIONAL TEST		
1.	Select COMPONENT TEST. Press 3 and ENTR buttons.	a. 3-COMPONENT TEST 1-DEEC TEST 2-EDU CELL 3-LOD TEST	

Table 1. DEEC Test Procedure (continued)

Step	Procedure	Normal Indication	Other Indication/Required Action
C. 2.	Select DEEC TEST. Press 1 and ENTR buttons.	a. 1-DEEC TEST	
		CONNECT CABLE W82 TO EAU J82M AND DEEC J82	BUILT-IN-TEST FAILURE DEEC POWER TEST
3.	Connect cables as depicted in figure 2. Press YES/CONT button when connection completed.		a.1. Replace EAU.
		a. CONNECT PLUGS TO DEEC P82 TO J81	
		P83 TO J83 P84 TO J84 P85 TO J85	
4.	Connect simulator plugs to DEEC as depicted in figure 2.		
5.	Press YES/CONT button.	a. DEEC TEST IN PROGRESS-WAIT	
		DEEC TEST PASS-CLEAR DATA? Y OR N	a. DEEC DATA FAILURE - TROUBLESHOOT
			a.1. Replace DEEC.

Table 1. DEEC Test Procedure (continued)

Step	Procedure	Normal Indication	Other Indication/Required Action
C.5. (cont'd)			b. ## DEEC TEST FAILURES - xxxx test b.1. Replace DEEC. c. DEEC DATA READ FAILURE - DEEC ID TEST c.1. DEEC and EAU are incompatible. Refer to paragraph 2.
6.	Do not clear data at this time. Press NO button.	a. 1-DEEC TEST 2-EDU TEST 3-LOD TEST	
7.	Press YES/CONT button.	a. 1-BUILT-IN-TEST 2-REVIEW DATA 3-COMPONENT TEST 4-REAL TIME READ 5-MEMORY R/W 6-REMOTE MODE 7-DEEC/EDU CLEAR 8-DOC DATA 9-DATA TRANSFER	

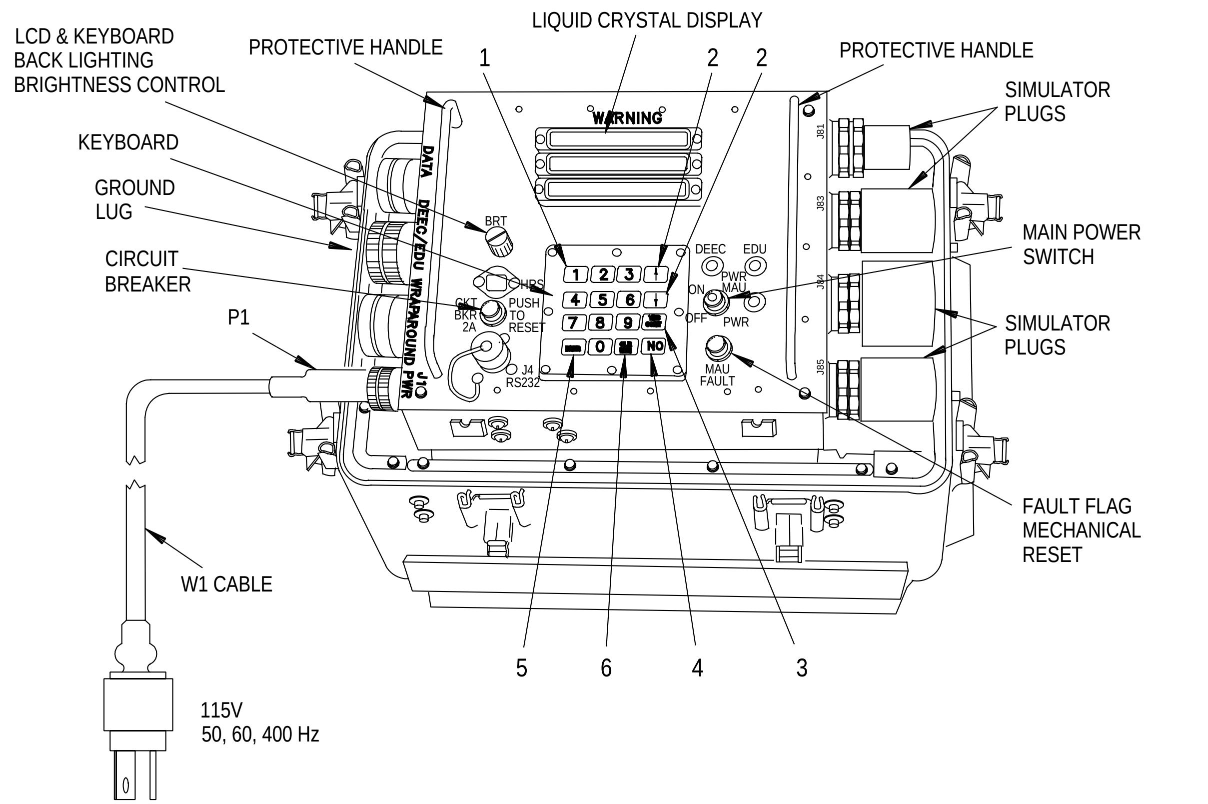
Table 1. DEEC Test Procedure (continued)

Step	Procedure	Normal Indication	Other Indication/Required Action
D.	POSTTEST PROCEDURE		

CAUTION

- To prevent damage to EAU, do not disconnect EAU from power source with EAU PWR switch ON.
- To prevent damage to DEEC, do not disconnect cables W82 or W82 EXT if EAU DEEC PWR light is on.

Step	Procedure	Normal Indication	Other Indication/Required Action
1.	If no further testing is required turn EAU PWR switch OFF. Turn OFF step-down transformer, if used.		
2.	If PWA 56032 is used, disconnect cables from engine, EAU, power source, and ground. Stow cables.		
3.	Remove simulator plugs from DEEC. Reconnect plugs to EAU.		
4.	Reconnect engine DEEC cables.		
5.	If EAU is not rack-mounted, install cover. Stow equipment.		



NUMBER	KEY	FUNCTION
1.	0 → 9	MENU SELECTION AND NUMERIC DATA ENTRY
2.	↑ ↓	LINE BY LINE SCROLLING
3.	YES/CONT	AFFIRMATIVE RESPONSE AND SEQUENCING FUNCTION
4.	NO	NEGATIVE RESPONSE
5.	ENTR	INITIATE PROCESSING OF MENU SELECTION OR DATA ENTRY
6.	CLR/RTN	CLEAR NUMERIC ENTRY AND RETURN TO PREVIOUS MENU

JN158 (37X2)

Figure 1. EAU Parts Identification: PWA 56032/PWA 56033 W1 Cable and EAU Power Cable Options (Sheet 1 of 2)

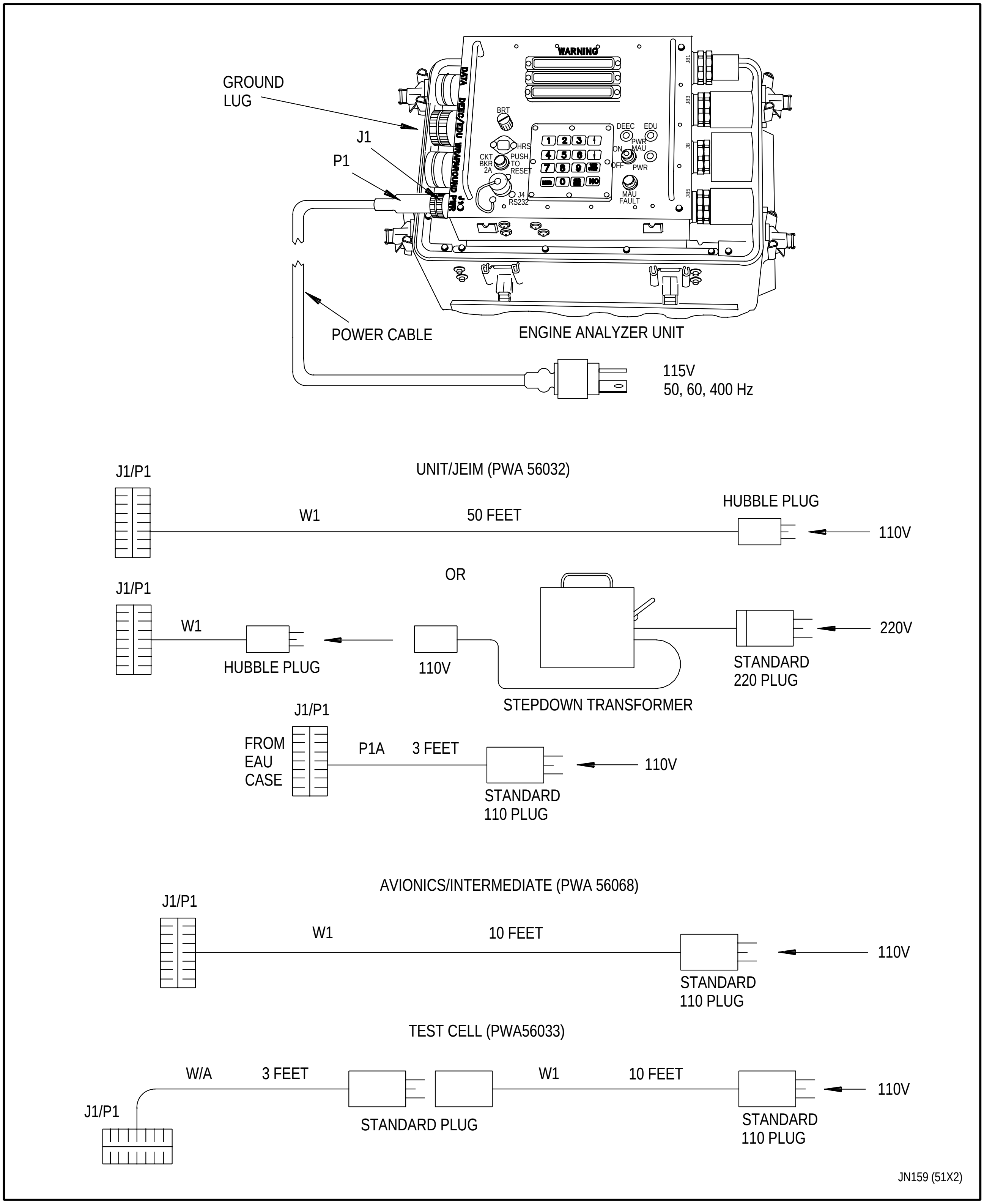


Figure 1. EAU Parts Identification: PWA 56032/PWA 56033 W1 Cable and EAU Power Cable Options (Sheet 2 of 2)

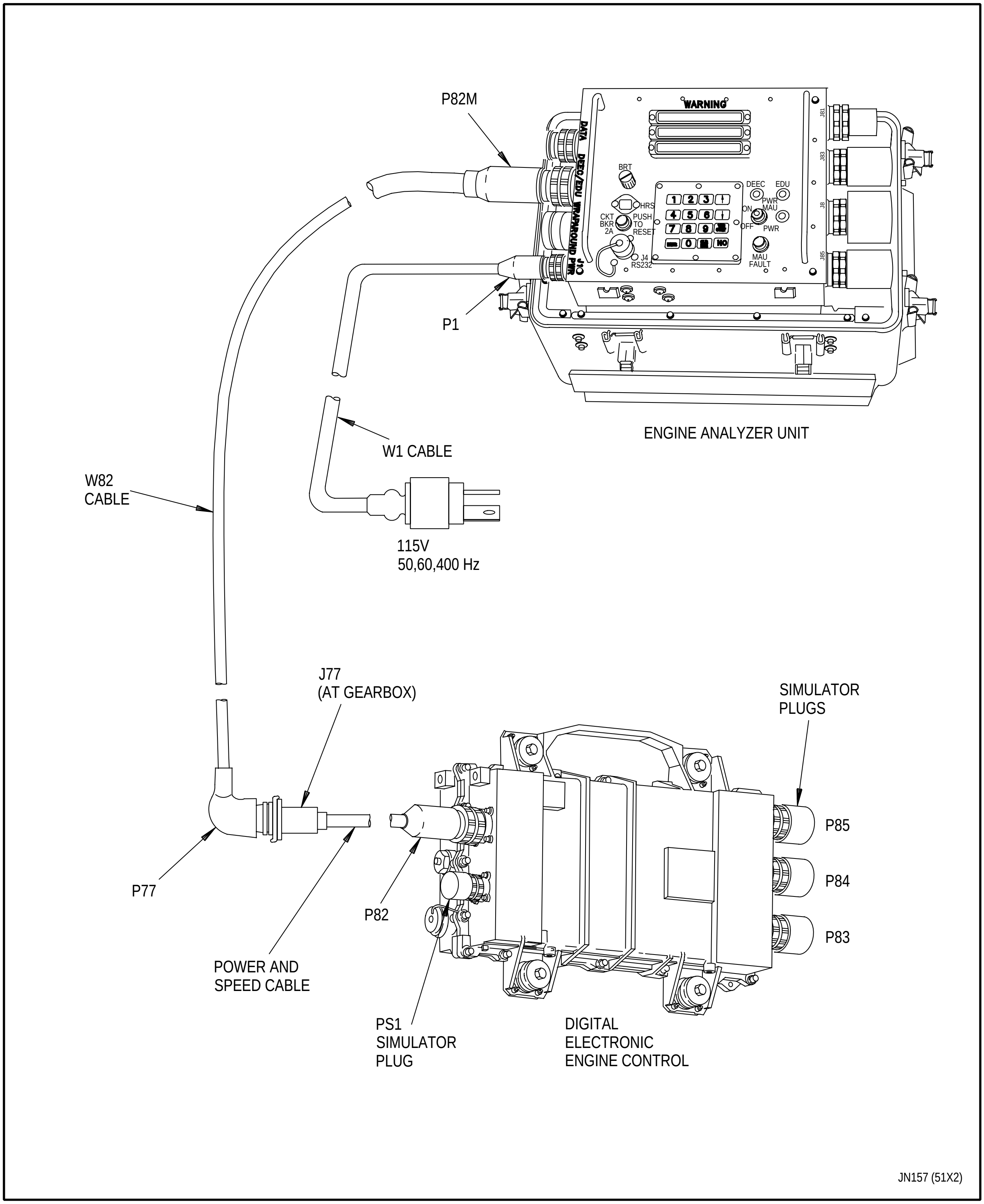


Figure 2. DEEC Functional Test

WORK PACKAGE

TECHNICAL PROCEDURES

MONITORING ENGINE PARAMETERS (REAL-TIME READ) USING CEDS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 18

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Troubleshooting	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
CEDS Built-In Testing	WP 182 00
CEDS Transfer Unit	T.O. 31S5-4-2142-2
Diagnostic System Interface Assembly	T.O. 33D4-6-745-2
Comprehensive Engine Diagnostic System (CEDS)	T.O. 33D4-6-746-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

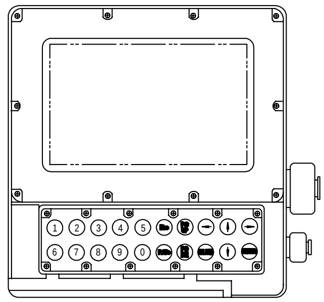
EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

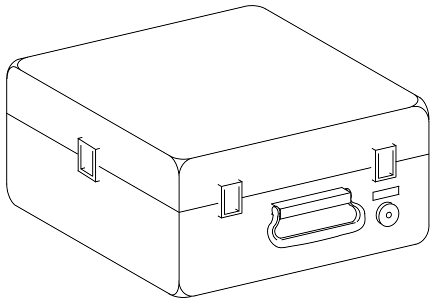
Paragraph	Function - Tool Nomenclature	Tool Number
	CEDS Software	PWA 56091
	Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114
	Floppy Disk Drive	Model/3401 or equivalent
2	CEDS Set-Up	
3	Display Editor	
4	DEEC/EDU Real-Time Monitor	
5	UART Transient Plots and Data	
6	Error Messages	
7	Static DEEC Monitor	
8	Post-Operation Procedures	

ILLUSTRATED SUPPORT EQUIPMENT



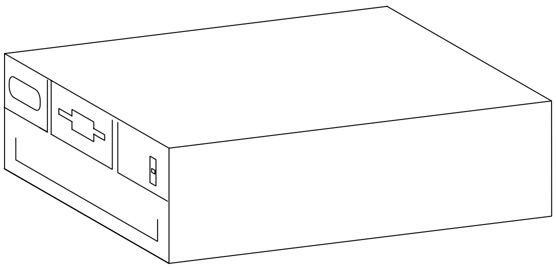
PWA 56102 –C

Figure T1. PWA 56102 Transfer Unit



PWA 56114 –C

Figure T2. PWA 56114 CEDS Interface Assembly



54347

Figure T3. Model/3401 Floppy Disk Drive

1. INTRODUCTION.

a. This work package contains procedures to monitor engine parameters (real-time read) using the Comprehensive Engine Diagnostic System (CEDS) (PWA 56091 software, PWA 56102 transfer unit, and PWA 56114 Diagnostic System Interface Assembly - DSIA).

b. Control parameters are output by the DEEC and EDU during operation.

c. REAL TIME MONITOR option allows operator to monitor engine operating parameters from EDU or DEEC. Fault codes will automatically be displayed on screen, as the fault code is generated by EDU or DEEC.

d. While monitoring engine parameters, several selections are available to perform additional functions as follows:

(1) RECORD UART DATA - EDU or DEEC transient UART data may be stored in a data file for later review. All DEEC or EDU parameters are recorded.

(2) FREEZE FRAME - Display parameters can be frozen to show immediate status, and printed.

(3) RECORD STATIC DATA - A frozen display showing a 5 second average of all display parameters, can be frozen for immediate use or recorded for later review.

(4) TOGGLE MONITOR - Toggles between monitoring of DEEC and EDU.

e. EDU DISPLAY EDITOR allows selection of EDU User Defined Parameters (UPS’s) from a master list of parameters, when required to monitor a parameter not present on a standard data set.

f. DEEC DISPLAY EDITOR allows selection of DEEC User Defined Parameters (UDPS’s) from a master list of parameters, when required to monitor a parameter not present on a standard data set.

g. UART PLOTS AND DATA REVIEW allows operator to display transit UART data files recorded during engine monitoring by one of three forms; tabular display, stacked plot, or overlay plot.

h. STATIC DATA REVIEW Allows operator to display static data files recorded during engine monitoring.

i. Deleted.

2. CEDS SET-UP.

(See Figures 1, 2, and 3.)

CAUTION

- To prevent erroneous operation, ensure J1, J77 or J82, and J146 are connected through proper cables between engine and CEDS before attempting CEDS/EDU/DEEC communications.
- Return to CEDS main menu before power off
- Press (PrtSc) key to print any screen

a. Figure 1 shows communication between elements of Engine Monitoring System (EMS). Figure 2 shows CEDS transfer unit. Figure 3 shows CEDS communication cable connections. Prepare CEDS for use. Refer to T.O. 33D4-6-746-1 and T.O. 31S5-4-2142-2.

b. Turn Interconnection Module (ICM) power switch on.

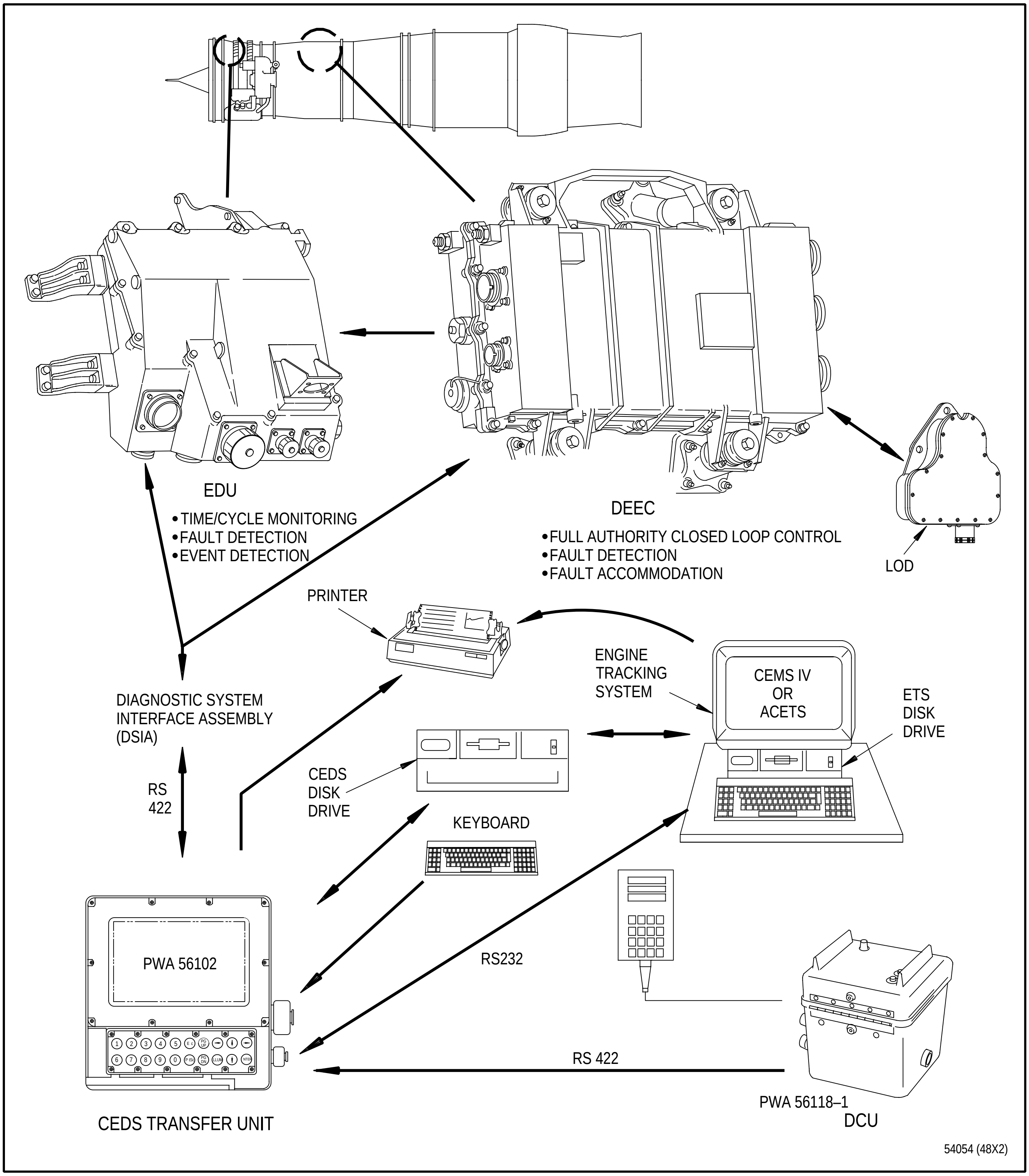


Figure 1. Engine Monitoring System

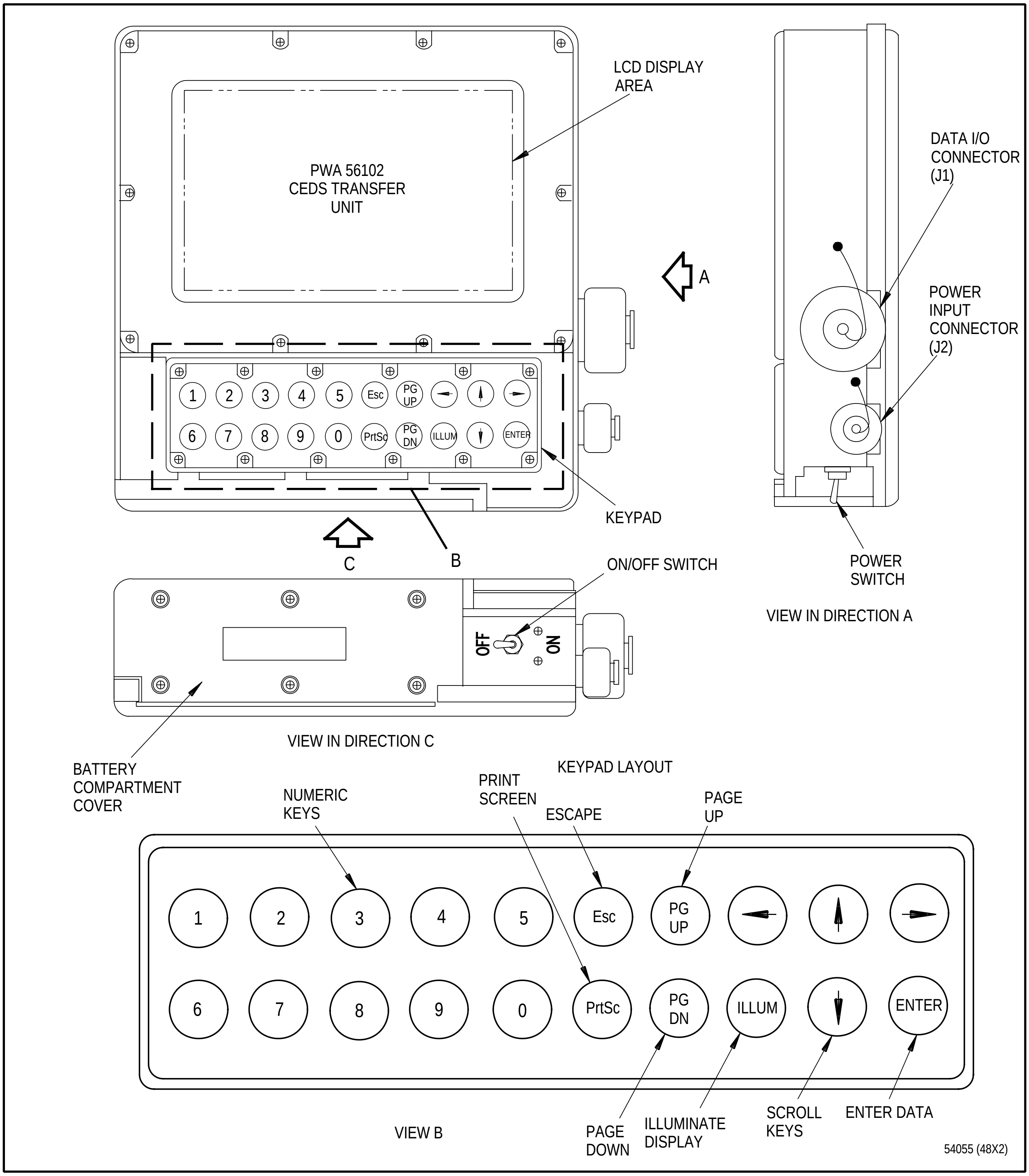


Figure 2.   CEDS Transfer Unit

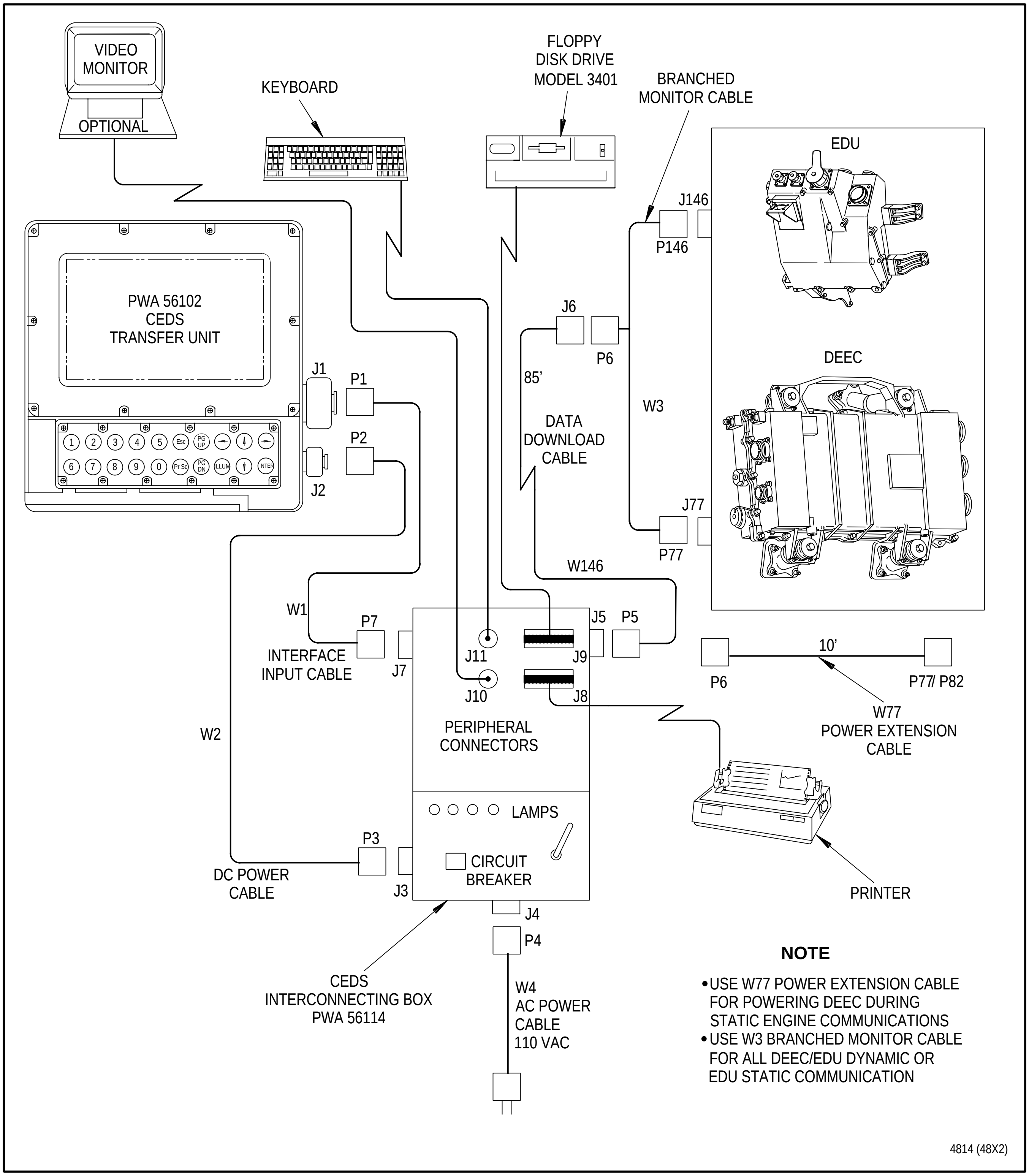


Figure 3. CEDS Communication Cable Connections

3. DISPLAY EDITOR.

(See figure 2 and Figure 4.)

NOTE

EDU and DEEC DISPLAY EDITOR functions allow selection of User Defined Parameters (UDPs). Standard engine data will always be displayed, but UDPs can be chosen, if required. EDU and DEEC DISPLAY EDITOR must be performed before REAL-TIME MONITOR begins.

a. CEDS has a standard data set of previously defined parameters for display. Any parameters outside this data set should be selected only when required. For normal monitoring, bypass the DISPLAY EDITOR function and go directly to EDU or DEEC REAL-TIME MONITOR function.

b. Starting with CEDS MAIN MENU, press (4) or select ENGINE MONITOR then press ENTER.

c. Perform EDU or DEEC DISPLAY EDITOR as follows:

(1) Press (3 or 4) or select EDU or DEEC DISPLAY EDITOR and press ENTER.

(2) Using up/down arrow key(s) or option number select Component Definition and Logic, press ENTER.

(3) Using arrow key(s), scroll through parameter list to required selection. Press (0) to select/deselect parameters (maximum of 4), (5) to clear all selections and (1) to quit and return to controlling menu.

(4) Press ENTER to update UDPs and return to ENGINE MONITOR menu.

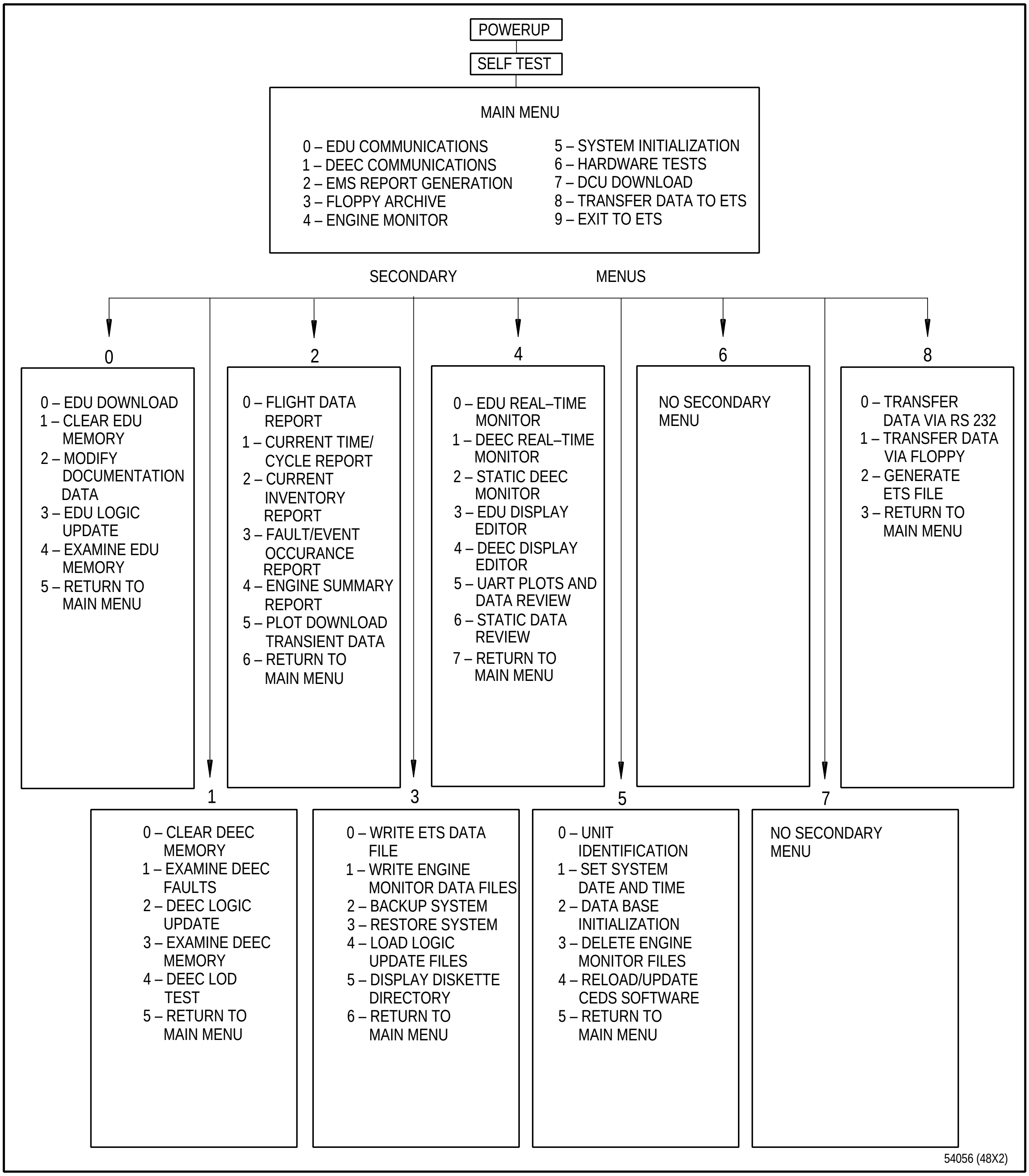


Figure 4. CEDS Operational Flow Chart

4. DEEC/EDU REAL-TIME MONITOR. (See figures 2 and 4.)

CAUTION

To prevent damage to CEDS and DEEC, do not use W77 power extension cable during dynamic DEEC-REAL-TIME MONITOR.

a. Starting with CEDS MAIN MENU, press (4) or select ENGINE MONITOR then press ENTER.

b. Perform REAL-TIME MONITOR as follows:

(1) Press (0 or 1) or select EDU or DEEC REAL-TIME MONITOR and press ENTER.

(2) Ensure proper cable connections (See figures 2 and 3). Press any key to continue.

NOTE

- During real-time monitor, fault codes may be displayed which are not stored in EDU and do not reflect true fault condition. Perform EDU DOWNLOAD after engine shutdown to determine actual fault codes.
- Before parameters are displayed, CEDS will identify components being monitored. After power is received by DEEC/EDU at (2000 RPM) N2, a 5 second delay may occur before monitoring will begin.
- Operator will be able to monitor 4 additional parameters from option (3 or 4), EDU or DEEC DISPLAY EDITOR. These will appear in User Defined Parameters (UDPs) area of display.

(3) Parameters will be displayed after CEDS determines component logic being monitored.

(4) Real-time monitoring will begin. Operator can select Record UART Data, Freeze Frame, Record Static or Exit monitor using arrow keys and pressing ENTER.

NOTE

When using RECORD UART DATA function, EDU or DEEC data, may be stored in a data file for later review. Once recording has begun operator may terminate it when desired or allow recording to continue for 1 minute. A 5-second buffer stores data prior to operator initiation of the recording, therefore enabling a maximum recording of (1 minute and 5 seconds). When recording has been terminated, operator is prompted for up to a 32 character label to identify the data set. This must be entered with an external keyboard else a default label is appended to user label to identify the data source. A total of 10 data recordings can exist in CEDS memory before oldest one is overwritten.

(5) Perform RECORD UART DATA AS FOLLOWS:

(a) Use up/down arrows to highlight RECORD UART DATA and press ENTER to start recording.

(b) Press ENTER at any time to stop recording. Once stopped operator will be prompted to "ENTER DATA IDENTIFICATION TITLE BELOW", up to 32 characters (using external keyboard).

(c) Press enter to input data into CEDS memory and return to Real Time Monitor display.

(6) Perform FREEZE FRAME as follows:

(a) Use up/down arrows to highlight FREEZE FRAME and press ENTER to freeze display.

(b) Press space bar on external keyboard or (6) on CEDS Transfer Unit to switch units of Pressure Parameters between psia and Hg.

NOTE

Title can only be entered using an external keyboard. If keyboard is not available title can be left blank.

(c) Using up/down arrows highlight "UNFREEZE DISPLAY" to continue monitoring or highlight "PRINT SCREEN" for a copy of the display. If PRINT SCREEN was selected you will be prompted to "ENTER TITLE for PRINTOUT" up to 32 characters (using external keyboard). Press ENTER to initiate printout and return to FREEZE FRAME display.

NOTE

The RECORD STATIC DATA function is a frozen display showing a 5 second average of all displayed parameters. It can be frozen for immediate use or recorded for later review. Later review is performed using STATIC DATA REVIEW function. A total of 10 static data recordings can exist in a CEDS memory before being overwritten. These averages can also be printed.

(7) Perform RECORD STATIC as follows:

(a) Use up/down arrows to highlight RECORD STATIC and press ENTER to display a 5 second average.

(b) Operator will be prompted to go "BACK TO MONITOR, SAVE STATIC DATA, or PRINT SCREEN". Highlight selection using up/down arrow keys and press ENTER. If SAVE STATIC SCREEN was selected, operator will be prompted to "ENTER DATA IDENTIFICATION TITLE BELOW" and for Print Screen "ENTER TITLE for PRINTOUT". The titles must be entered with an external keyboard or left blank if keyboard is not available.

c. Scroll back to monitor, and press ENTER to return to Engine Monitor Menu.

NOTE

TOGGLE MONITOR function allows operator to switch between REAL-TIME monitoring of DEEC and EDU.

8. Perform TOGGLE MONITOR as follows:

   (1) Use up/down arrows to highlight TOGGLE MONITOR and press ENTER to switch between EDU and DEEC real-time monitoring.

5. UART TRANSIENT PLOTS AND DATA.

(See figures 2 and 4.)

a. Starting with CEDS MAIN MENU, press (4) or select ENGINE MONITOR then press ENTER.

b. Perform UART PLOTS AND DATA REVIEW as follows:

   (1) Press (5) or select UART PLOTS & DATA REVIEW and press ENTER.

   (2) Using up/down arrow key(s), scroll through data files for selection desired and press ENTER.

   (3) Operator will be prompted by a sub-menu to select (1) PARAMETER MENU, (2) DEFINE DATA WINDOW, or (3) RETURN TO MONITOR MENU. Select desired menu option number or highlight using up/down arrow key(s) and press ENTER.

   (4) If PARAMETER MENU is selected refer to step (7).

   (5) If DEFINE DATA WINDOW is selected operator will be prompted to enter start time and ending time of data window using numeric key(s) on CEDS Transfer Unit or external keyboard, and pressing ENTER after each selection.

   (6) Press ENTER again to return to calling menu.

NOTE

User will be provided display of UART data parameters. User may select one "X" parameter and up to 4 "Y" parameters through a cursor controlled selection process. There are no limitations placed upon which axis the parameter can be displayed. On bottom of screen a series of commands are displayed and made available to the operator. Some commands automatically initiate desired process, others require further operator input.

   (7) Operator will be prompted to select one "X" parameter and press (0) a second time to deselect.

   (8) Operator will be prompted to select up to four "Y" parameter(s). Once a parameter has been highlighted press (5) to enter, or press (5) a second time to deselect. Repeat steps (7) and (8) to change or select 4 "Y" parameters.

NOTE

- Stack Plot (STKPLT) option allows up to four separate "Y" axis parameters plotted against "X" axis and "stacked" one on top of another. Selection of this option results in UART plots reading in appropriate data parameters, determine min/max values and autoscale data for acceptable plot characteristics. Plots are labeled with engineering unit values, parameter names and identification title associated with the data record.
- Overlay Plot (OVLPLT) generated by this command is similar to those produced by STKPLT. The difference is that all "Y" parameters are overlaid on one graph using a common "Y" axis scale with each line uniquely marked.
- Tabulate Transient Data (TAB) command produces a table listing all UART data values recorded for the parameters selected.
- Escape (ESC) will cause termination of TPLOTS and returns operator control to the main menu.

(9) Select (2) STKPLT, (3) OVLPLT, or (4) TAB to examine data desired. Press PRTSC to initiate screen dump of existing plot or data display. If desired, operator can return to calling menu by pressing (1) QUIT, this would allow operator to select or change DEFINE DATA WINDOW (starting and ending time of the data window).

NOTE

- Point Track (PT TRK) command places crosshairs on all plot lines. Crosshairs are placed in middle of graph with data values of each parameter displayed at top of screen. Crosshairs can be moved left and right to next data point on graph with arrow keys while values will be updated at the top.
- Fast Track (FASTRK) command is similar to "PT TRK" except that instead of tracking each point along graph, FASTRK skips along graph in increments of 1/20th the total number of scans recorded.
- Rescale Axes (RESCALE) is used to examine data more closely, the operator may change size of data window. This command prompts operator to modify the minimum and maximum values for each selected parameter n produce a rescaled plot.

(10) Press (1) to quit data examination at any time.

(11) Press PRTSC to initiate a screen dump of the existing plot or data display. If printer is connected and printout is desired.

(12) If STKPLT or OVLPLT were selected, you may select (2) PT TRK or FASTRK to examine data at a particular point, if you need to examine data more closely press (4) RESCALE. If TAB was selected go to next step.

(13) During TAB command you will be allowed to scroll either backward or forward throughout this table using up or down arrow keys.

(14) Press ESC key to return to Main Menu.

6. ERROR MESSAGES.

(See figures 1 through 4.)

NOTE

Following six Communication Diagnostic ERROR messages, first line gives indication of operation being performed and second line will give Error number. Although messages are worded differently, corrective actions are all the same.

MESSAGE	CORRECTIVE ACTION
Communication Diagnostic ERROR messages are numbered as follows: 1-Timeout on block transfer 2-Block transmission error 3-No.ACK received from EDU/DEEC 4-No handshake with EDU/DEEC 5-Data written/received mismatch 6-SYNC words not found	• Record error message. • Perform Check on Transfer Unit battery/power supply and DSIA cables. Refer to T.O. 33D4-6-745-2. • Retry COMMUNICATIONS. • Perform Transfer Unit HARDWARE TESTS. Refer to T.O. 31S5-4-2142-2. Replace Transfer Unit if test fails. • Replace DEEC/EDU.
Begin handshake with DCU	• Check cable connections (W7 and W101).
Sending request for size command	• Check DCU battery.
Sending request for data command	• Try again (recycle DCU).
Receiving DCU blocks... Transmission failed - errors detected! Press any key to continue...	• Perform Loop back check (EBIT). Refer to T.O. 31S5-4-2142-2. Replace Transfer Unit if test fails.

MESSAGE	CORRECTIVE ACTION
Drive not ready (0) Abort, (1) Retry?	• Check floppy drive cable connections. • Check floppy drive to ensure diskette is properly inserted. • Retry • Replace floppy disk drive
No EDU update files exist! Press any key to continue...	• Update file has been deleted (more than 15 days). Reload files. • Retry disk or try new disk.
Performing file integrity checks... Update file integrity checks failed, process aborted! Press any key to continue...	• Reload logic update file.
Performing file integrity checks... EDU EEPROM ID more recent than attempted update, process aborted! Press any key to continue...	• Operator has tried to load an older revision than what the Transfer Unit has stored in memory. Check revision status and reload correct version.
Receiving UART, waiting for valid program identification	• Wait for proper engine N2 RPM (2000) and try again. • Possibility of a bad memory in EDU/ DEEC. Start engine, shut down and restart engine. Replace EDU/DEEC if required.
WARNING: Duplicate engine data, download not stored in data base! ENGSN : 740000 ACTN : 00-0000 EDUSM : BEDU0009 EDU ID : 5-020102 EDU EEPROM : 005 (Typical Data)	• This prevents CEMS IV from getting overloaded with perviously stored data.
Unable to identify correct Fault Codes	• Invalid data is present in EDU fault counter registers. • Perform EXAMINE DEEC FAULTS.

7. STATIC DEEC MONITOR.
(See figures 2, 3, and 4.)

NOTE

Ensure W146 engine monitor cable and W77 power extension cables are in series between tester and engine J77.

a. Starting with CEDS MAIN MENU, press (4) or select ENGINE MONITOR then press enter.

b. Perform STATIC DEEC MONITOR as follows:

(1) Press (2) or select STATIC DEEC MONITOR and press ENTER.

(2) Ensure proper cable connects. Press any key to continued.

(3) Once DEEC Monitor is displayed, operator can select FREEZE FRAME from CEDS MENU and press ENTER. Operator will be prompted to press space bar on external keyboard or (6) on CEDS transfer unit to convert PSIA to Hg.

(4) Press PRTSC on CEDS transfer unit, or select PRINT SCREEN from CEDS MENU and press ENTER to initiate a screen dump of existing data display (if required).

(5) To return to ENGINE MONITOR menu, select EXIT MONITOR and press ENTER. Press (7) or select RETURN TO MAIN MENU then press ENTER, or press (Esc).

(6) Turn CEDS transfer unit POWER switch OFF after data examination is complete.

8. POST-OPERATION PROCEDURES.
(See figures 1 through 4.)

CAUTION

- To prevent possible damage to CEDS, EDU, and DEEC, do not disconnect cables from engine and CEDS J1, J77 or J82, and J146 during CEDS/EDU/DEEC communications.
- Failure to turn computer Power switch OFF before disconnecting CEDS may cause damage to CEDS.

a. Press ESC key to return to MAIN MENU.

b. Turn CEDS computer POWER switch OFF.

WORK PACKAGE

TECHNICAL PROCEDURES

EAU BUILT-IN TEST

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 20

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 19	0				
20 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Engine Analyzer Unit - Operation Instructions (This unit is designated as a jet engine analyzer unit in referenced technical manual.)	T.O. 33D4-6-684-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	EAU Built-in Test	
	Interface cables	PWA 56032 PWA 56033
	Engine analyzer unit	PWA 56084

ILLUSTRATED SUPPORT EQUIPMENT

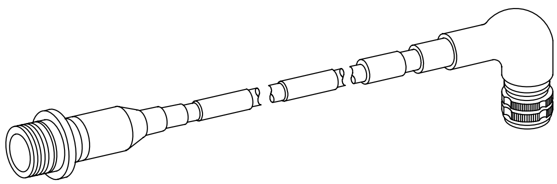


Figure T1. PWA 56032/PWA 56033 Interface Cable (Typical)

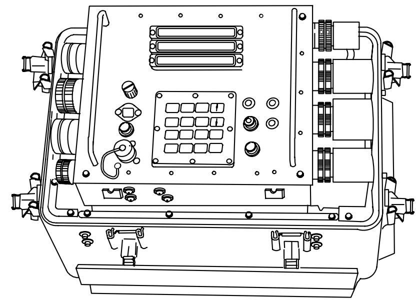


Figure T2. PWA 56084 Engine Analyzer Unit

1. INTRODUCTION.

a. This work package contains Engine Analyzer Unit (EAU) BUILT-IN-TEST procedures.

b. These procedures are performed when PWA 56084 is suspected or confirmed to be malfunctioning.

c. The EAU operator is required to connect specific interface cable sets and push indicated buttons throughout these procedures.

2. EAU BUILT-IN TEST.

(See Figures 1 through 4, and Table 1.)

a. Perform PWA 56084 EAU BUILT-IN-TEST per table 1.

Table 1. PWA 56084 EAU Built-In-Test

Step	Procedure	Normal Indication	Other Indication/Required Action
A.	EAU SET-UP (See figure 1.)		
1.	Remove EAU cover.		

WARNING

To prevent injury to personnel or damage to EAU, ensure EAU is properly grounded before applying electrical power.

Step	Procedure	Normal Indication	Other Indication/Required Action
2.	Properly ground EAU.		

CAUTION

Ensure EAU PWR switch is OFF before connecting or disconnecting electrical power.

Step	Procedure	Normal Indication	Other Indication/Required Action
3.	Turn EAU PWR switch OFF.		

CAUTION

- PWA 56032 cable set case step-down transformer shall be used if EAU power source is 220 Vac. Failure to use transformer may damage EAU, even with EAU PWR switch OFF.
- Do not use transformer if EAU power supply is 110 to 125 Vac. Use of step-down transformer with 110 Vac power source will cause erroneous EAU operation and may damage EAU.

Step	Procedure	Normal Indication	Other Indication/Required Action
4.	Connect W1 power cable to EAU J1 connector. See figure 1.		
5.	Ensure power supply is 110 to 125 Vac.	a. Voltage and frequency within limits	a. Go to step 6.
		b. Voltage and frequency out of limits.	b. Repair or replace power source.
6.	Plug W1 cable into power supply.		

Table 1. PWA 56084 EAU Built-In-Test (continued)

Step	Procedure	Normal Indication	Other Indication/Required Action
A.6.a.	If step-down transformer is used, plug W1 cable into Hubble plug of transformer.		
6.b.	Turn transformer power switch OFF.		
6.c.	Connect transformer to 220 Vac power supply.		

CAUTION

Loss of engine-driven electrical power due to fuel starvation may cause a destructive current surge through the EAU. Ensure an adequate fuel supply before starting.

Step	Procedure	Normal Indication	Other Indication/Required Action
6.d.	Turn transformer ON.		
B.	EAU SELF TEST		
1.	Turn EAU PWR switch ON.	a. EAU SELF-TEST IN PROGRESS-WAIT	
		EAU SELF-TEST PASSED EAU ID 1-020100	a. EAU SELF-TEST FAILURE xxxx test
2.	Press YES/CONT button.	a. INDICATE EAU LOCATION 1-FLIGHT LINE	a.1. Replace EAU.
		2-TEST CELL 3-BENCH TEST	

Table 1. PWA 56084 EAU Built-In-Test (continued)

Step	Procedure	Normal Indication	Other Indication/Required Action
B. 3.	Determine cable set in use: PWA 56032 - Flight Line PWA 56033 - Test Cell Press corresponding number and ENTR buttons.	a. # -xxxx xxxx 1-BUILT-IN-TEST 2-REVIEW DATA 3-COMPONENT TEST 4-REAL TIME READ 5-MEMORY R/W 6-REMOTE MODE 7-DEEC/EDU CLEAR 8-DOC DATA 9-DATA TRANSFER	
4.	Select BUILT-IN-TEST. Press 1 and ENTR buttons.	a. 1-BUILT-IN-TEST EAU-SELF-TEST IN PROGRESS-WAIT EAU-SELF-TEST PASSED EAU ID 1-020100	a. EAU-SELF-TEST FAILURE xxxx test a.1. Replace EAU.

Table 1. PWA 56084 EAU Built-In-Test (continued)

Step	Procedure	Normal Indication	Other Indication/Required Action
B. 5.	Press YES/CONT button.	a. 1-SIM PLUGS TEST 2-KYBD/DISPLAY 3-CABLE TEST	
6.	Select SIMS PLUGS TEST. Press 1 and ENTR buttons.	a. 1-SIM PLUGS TEST CONNECT PLUGS TO EAU P8 to J81 P83 to J83 P84 to J84 P85 to J85	
7.	Ensure simulator plugs are installed on EAU. Press YES/ CONT button.	a. SIMS PLUG TEST IN PROGRESS-WAIT SIM PLUG TEST PASSED	a. SIM PLUG TEST FAILURE PLUG xxx a.1. Ensure plugs are attached securely. Repeat test. Replace EAU if test fails.
8.	Press YES/CONT button.	a. 1-SIM PLUGS TEST 2-KYBD/DISPLAY 3-CABLE TEST	

Table 1. PWA 56084 EAU Built-In-Test (continued)

Step	Procedure	Normal Indication	Other Indication/Required Action
B. 9.	Select KYBD/DISPLAY TEST. Press 2 and ENTR buttons.	a. 2-KYBD/DISPLAY DISPLAY PRESS CONT AFTER EACH DISPLAY	
10.	Press YES/CONT button.	a. *********** *********** ***********	a. * * *** ** *** *** ** *** ** ** a.1. Note bad display(s). Replace EAU.
11.	Inspect display for unlit segments.		
12.	Repeat steps 10 and 11 for each display pattern.	a. KYBD TEST-PRESS EACH KEY - PRESS CONT LAST -	
13.	Press each button and observe echo on display: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, UP arrow, DOWN arrow, ENTR, CLR/RTN, NO. If any button does not work, note failure and continue test.		
14.	Press YES/CONT button.	a. 1-SIM PLUGS TEST 2-KYBD DISPLAY 3-CABLE TEST	

Table 1. PWA 56084 EAU Built-In-Test (continued)

Step	Procedure	Normal Indication	Other Indication/Required Action
B.15.	Select CABLE TEST. Press 3 and ENTR buttons.	a. [3-CABLE TEST] [1-W3/W146 2-W82 3-W82/W82 EXT]	
16.	Select W3/W146. Press 1 and ENTR buttons.	a. [1-W3/W146] PWA 56032 cable set [CONNECT CABLES W3 AND W146 TO EAU] [P82M TO J82M P146 TO J146 P3 TO J3] -OR- PWA 56033 cable set [CONNECT CABLES W3 W/A AND W146 W/A TO EAU] [P82M TO J82M P146 TO J146 P3 TO J3]	a. [BUILT-IN-TEST FAILURE - XXXX TEST] a.1. Replace EAU.

Table 1. PWA 56084 EAU Built-In-Test (continued)

Step	Procedure	Normal Indication	Other Indication/Required Action
B.17.	Connect cable set as depicted in figure 2. Press YES/CONT button.	a. CABLE TEST IN PROGRESS-WAIT	
		W3/W146 CABLE TST PASSED	a. W3/W146 CABLE TST FAILURE XXXX TEST a.1. Replace EAU.
18.	Press YES/CONT button.	a. 1-W3/W146 2-W82 3-W82/W82 EXT	
19.	Select W82. Press 2 and ENTR buttons	a. 2-W82 PWA 56032 cable set CONNECT CABLES W82 TO EAU P82M TO J82M P82 TO J2	

Table 1. PWA 56084 EAU Built-In-Test (continued)

Step	Procedure	Normal Indication	Other Indication/Required Action
B.19. (cont'd)		-OR- PWA 56033 cable set CONNECT CABLES W82 W/A TO EAU	
		P82M TO 582M P82 TO J52	a. BUILT-IN-TEST FAILURE - XXXX TEST a.1. Replace EAU.
20.	Connect cable set as depicted in figure 3.	a. CABLE TEST IN PROGRESS-WAIT	
		W82 CABLE TEST PASSED	a. W82 CABLE TEST FAILURE a.1. Replace EAU.
21.	Press YES/CONT button.	a. 1-W3/W146 2-W82 3-W82/W82 EXT	
22.	Select W82/W82 EXT. Press 3 and ENTR buttons.	a. 3-W82/W82 EXT	

Table 1. PWA 56084 EAU Built-In-Test (continued)

Step	Procedure	Normal Indication	Other Indication/Required Action
B.22. (cont'd)		PWA 56032 cable set	
		CONNECT CABLES W82 AND W82 EXT P82M TO J82M	
		P82 TO J82 P77 TO J2	a. BUILT-IN-TEST FAILURE - XXXX TEST
			a.1. Replace EAU.
			b. PWA 56033 NO W82 EXT CABLE
			b.1. If using PWA 56033, go to step C.
23.	Connect cable set as depicted in figure 4.	a. CABLE TEST IN PROGRESS-WAIT	
		W82 CABLE TEST PASSED	a. W82X CABLE TEST FAILURE XXXX TEST
			a.1. Replace EAU.
24.	Press YES/CONT button.	a. 1-W3/W146 2-W82 3-W82/W82 EXT	

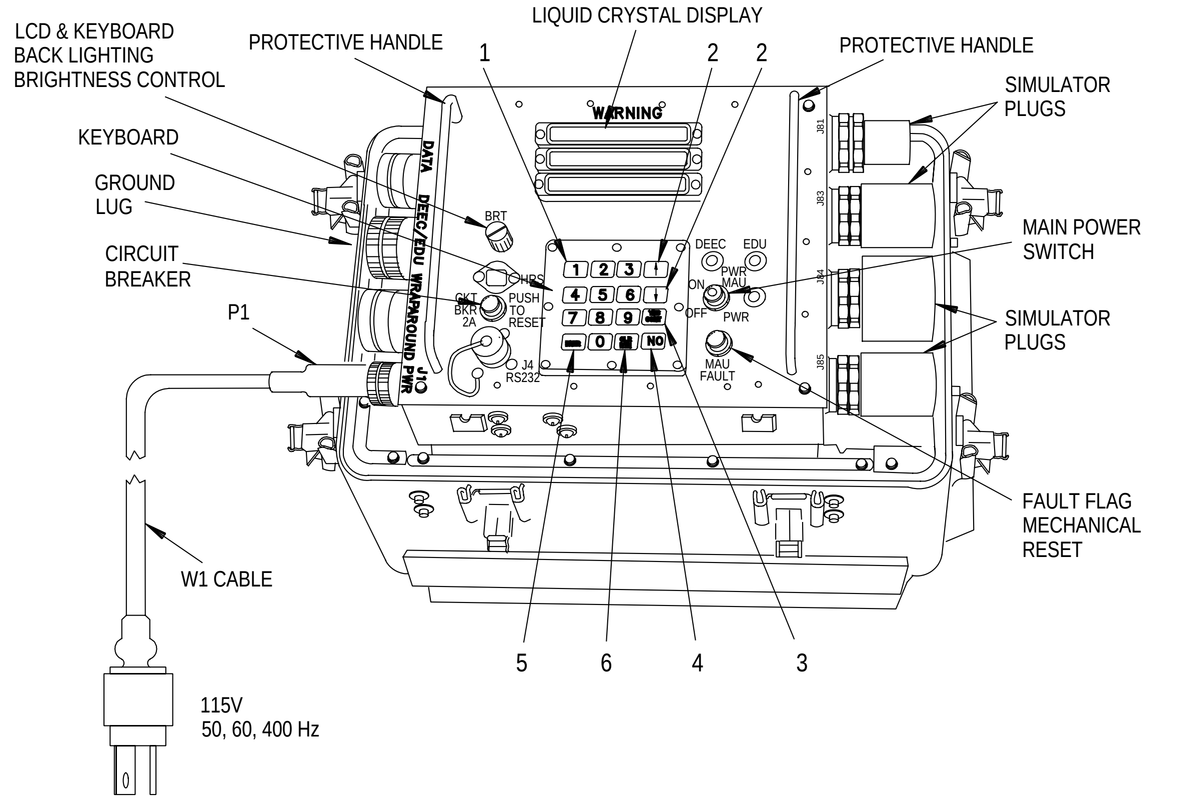
Table 1. PWA 56084 EAU Built-In-Test (continued)

Step	Procedure	Normal Indication	Other Indication/Required Action
B.25.	Press CLR/RTN button.	a. 1-SIM PLUGS TEST 2-KYBD/DISPLAY 3-CABLE TEST	
26.	Press CLR/RTN button.	a. 1-BUILT-IN-TEST 2-REVIEW DATA 3-COMPONENT TEST 4-REAL TIME READ 5-MEMORY R/W 6-REMOTE MODE 7-DEEC/EDU CLEAR 8-DOC DATA 9-TRANSFER DATA	
C.	POSTTEST PROCEDURE		

CAUTION

To prevent damage to EAU, do not disconnect EAU from power source with EAU PWR switch ON.

Step	Procedure	Normal Indication	Other Indication/Required Action
1.	If no further testing is required, turn EAU PWR switch OFF. Turn OFF step-down transformer, if used.		
2.	If PWA 56032 is used, remove cables from connectors. Stow cables. Disconnect EAU ground cable.		
3.	If EAU is not rack-mounted, install EAU cover.		



NUMBER	KEY	FUNCTION
1.	0 ——► 9	MENU SELECTION AND NUMERIC DATA ENTRY
2.	↑ ↓	LINE BY LINE SCROLLING
3.	YES/CONT	AFFIRMATIVE RESPONSE AND SEQUENCING FUNCTION
4.	NO	NEGATIVE RESPONSE
5.	ENTR	INITIATE PROCESSING OF MENU SELECTION OR DATA ENTRY
6.	CLR/RTN	CLEAR NUMERIC ENTRY AND RETURN TO PREVIOUS MENU

JN158 (37X2)

Figure 1. EAU Parts Identification: PWA 56032/PWA 56033 W1 Cable and EAU Power Cable - Options (Sheet 1 of 2)

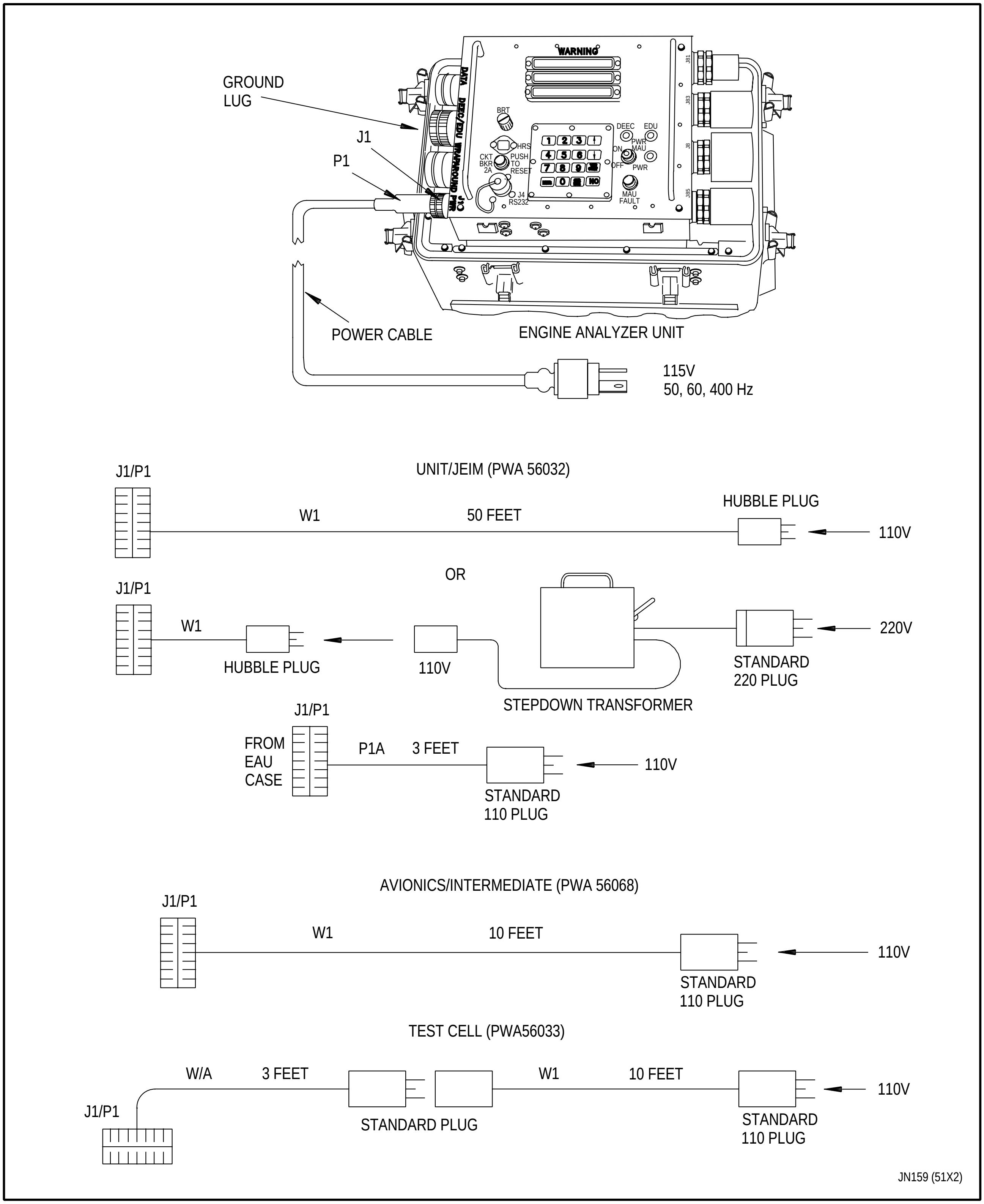


Figure 1. EAU Parts Identification: PWA 56032/PWA 56033 W1 Cable and EAU Power Cable - Options (Sheet 2 of 2)

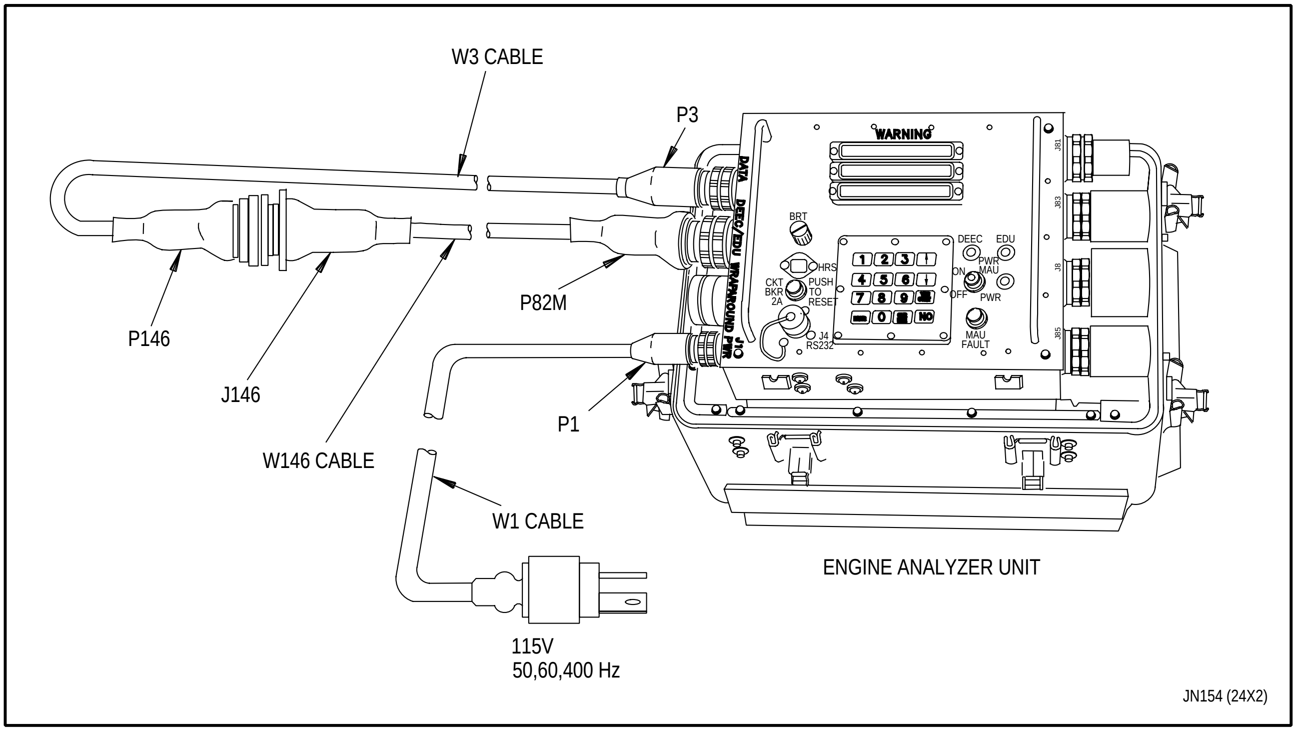


Figure 2. EAU PWA 56032/PWA 56033 W3/W146 Cable - Test

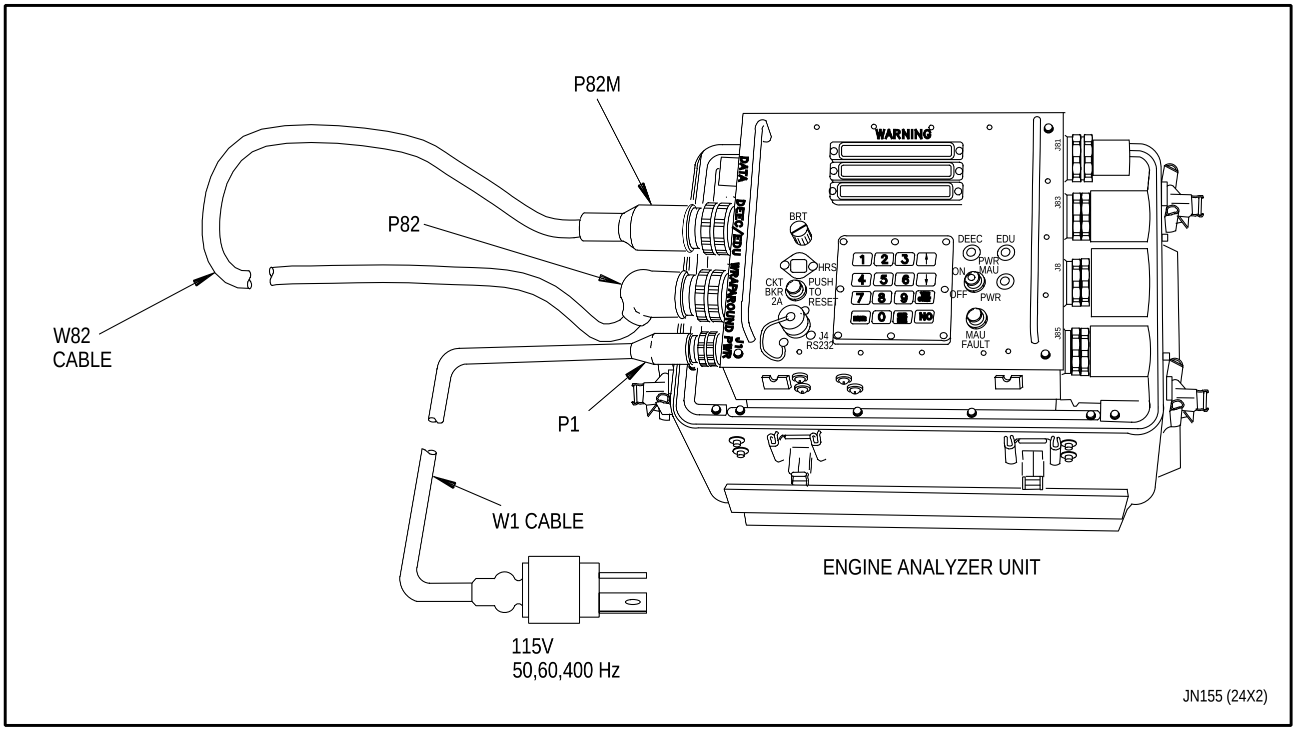


Figure 3. EAU PWA 56032/PWA 56033 W82 Cable - Test

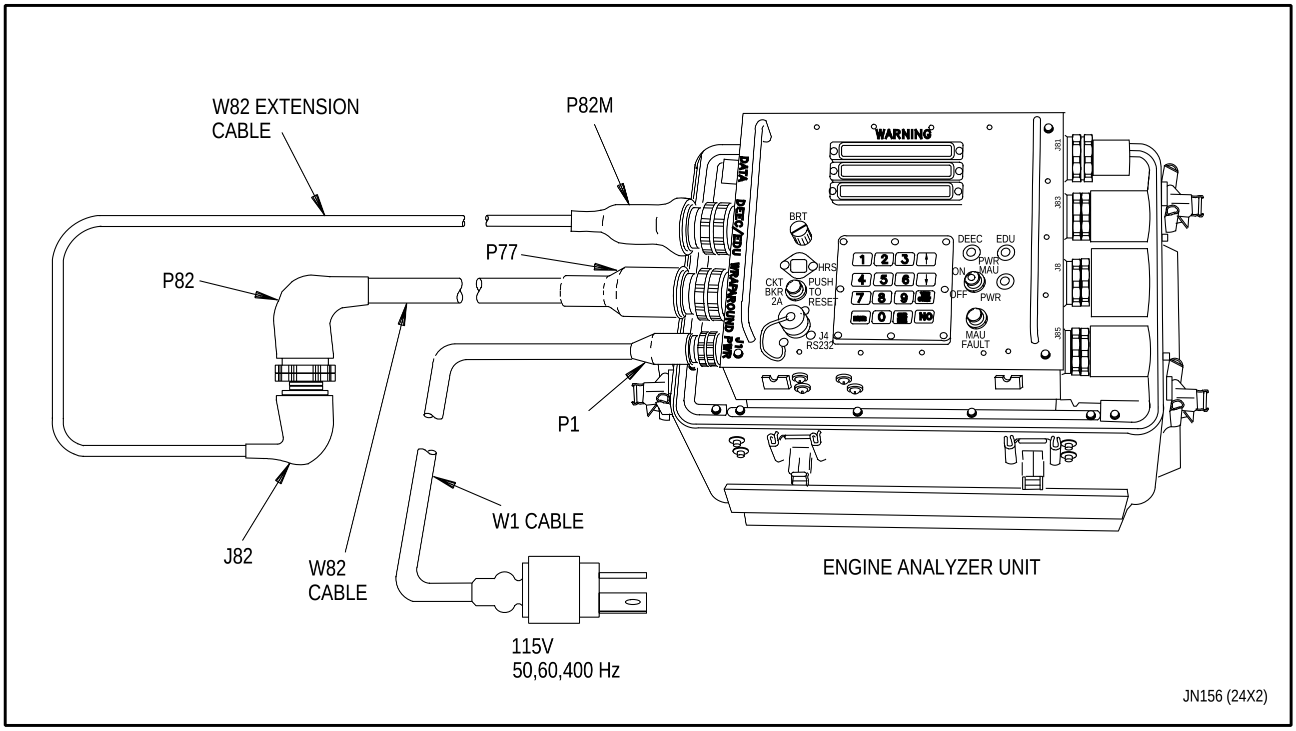


Figure 4.   EAU PWA 56032 W82/W82 Extension Cable - Test

WORK PACKAGE

TECHNICAL PROCEDURES

CHANGING EDU DOCUMENTARY DATA USING CEDS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 12	12				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Troubleshooting	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
CEDS Transfer Unit	T.O. 31S5-4-2142-2
Diagnostic System Interface Assembly	T.O. 33D4-6-745-2
Comprehensive Engine Diagnostic System (CEDS)	T.O. 33D4-6-746-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

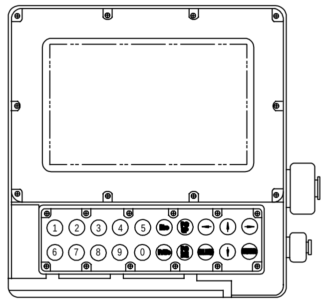
EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

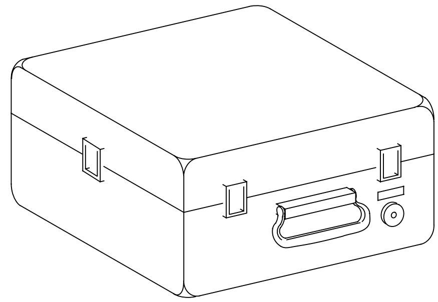
Paragraph	Function - Tool Nomenclature	Tool Number
	CEDS Software	PWA 56091
	Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114
	Floppy Disk Drive	Model/3401 or equivalent
2	CEDS Set-Up	
3	Modify Documentation Data	
4	Error Messages	
5	Post-Operation Procedures	

ILLUSTRATED SUPPORT EQUIPMENT



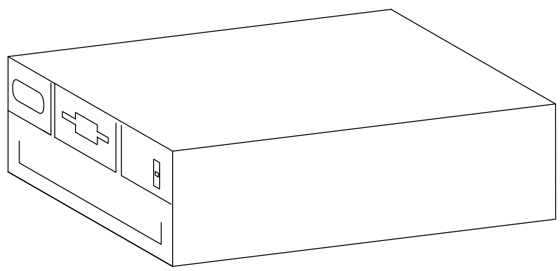
PWA 56102 –C

Figure T1. PWA 56102 Transfer Unit



PWA 56114 –C

Figure T2. PWA 56114 CEDS Interface Assembly



54347

Figure T3. Model/3401 Floppy Disk Drive

1. INTRODUCTION.

a. This work package contains procedures to change EDU documentary data using the Comprehensive Engine Diagnostic System (CEDS) (PWA 56091 software, PWA 56102 transfer unit, and PWA 56114 Diagnostic System Interface Assembly - DSIA).

b. Modify documentation data option allows operator to change documentary data within EDU. Aircraft tail number, engine serial number, EDU serial number, and change of any serially tracked part (STP) on engine, are parameters that can be changed.

c. Following the completion of this function CEDS will automatically perform an EDU download to record time/cycle meter readings essential to the Engine Tracking System (ETS).

2. CEDS SET-UP.

(See Figures 1, 2, and 3.)

a. Figure 1 shows CEDS communication between elements of Engine Monitoring System(EMS).
Figure 2 shows CEDS communication between elements of Transfer Unit.
Figure 3 shows CEDS communication cable connections.
Prepare CEDS for use. Refer to T.O. 33D4-6-746-1 and T.O. 31S5-4-2142-2.

CAUTION

To prevent erroneous operation, ensure J1 and J146 are connected through proper cables between engine and CEDS before attempting CEDS/EDU communications.

b. Turn Interconnection Module (ICM) computer POWER switch ON.

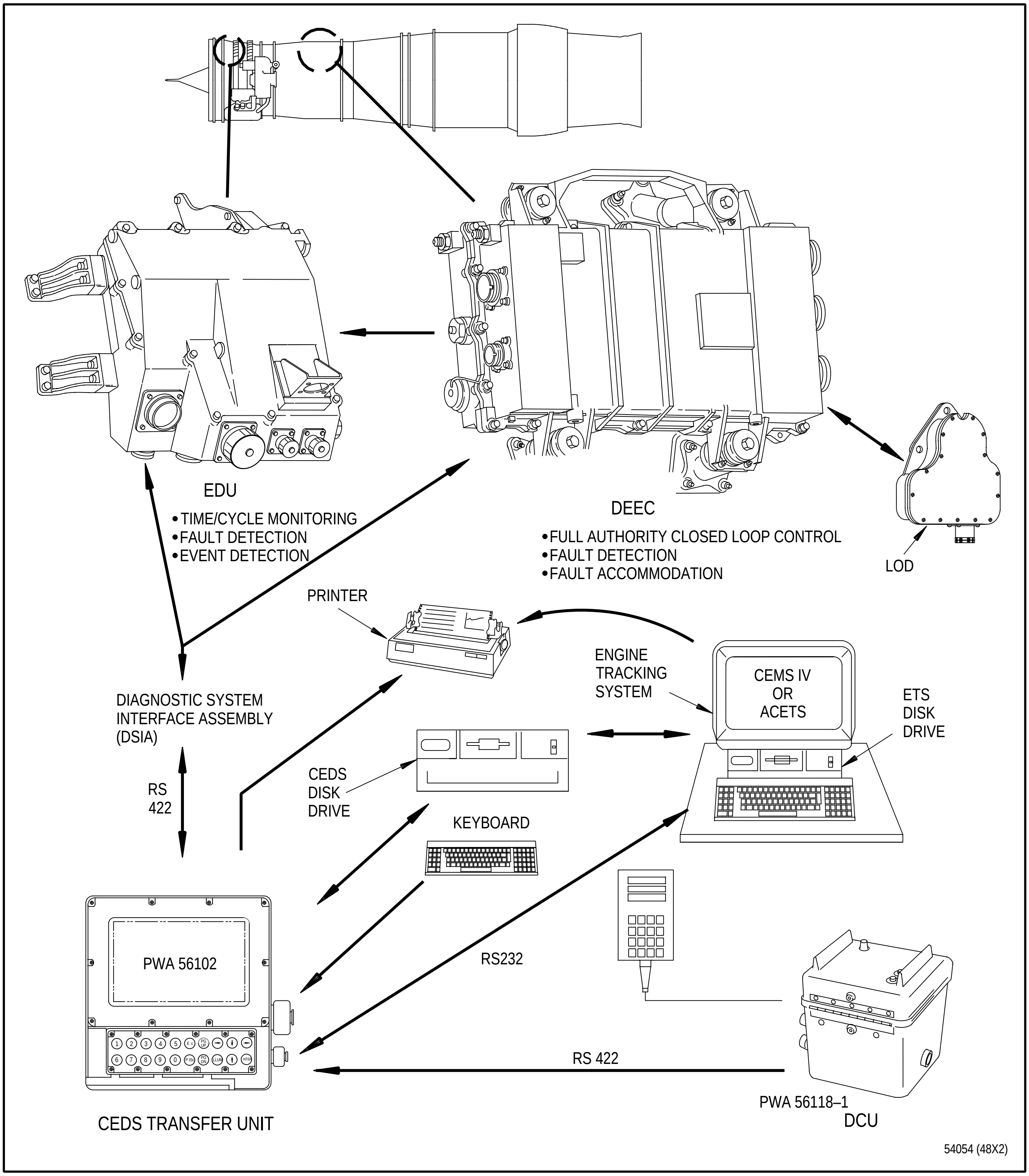


Figure 1. Engine Monitoring System

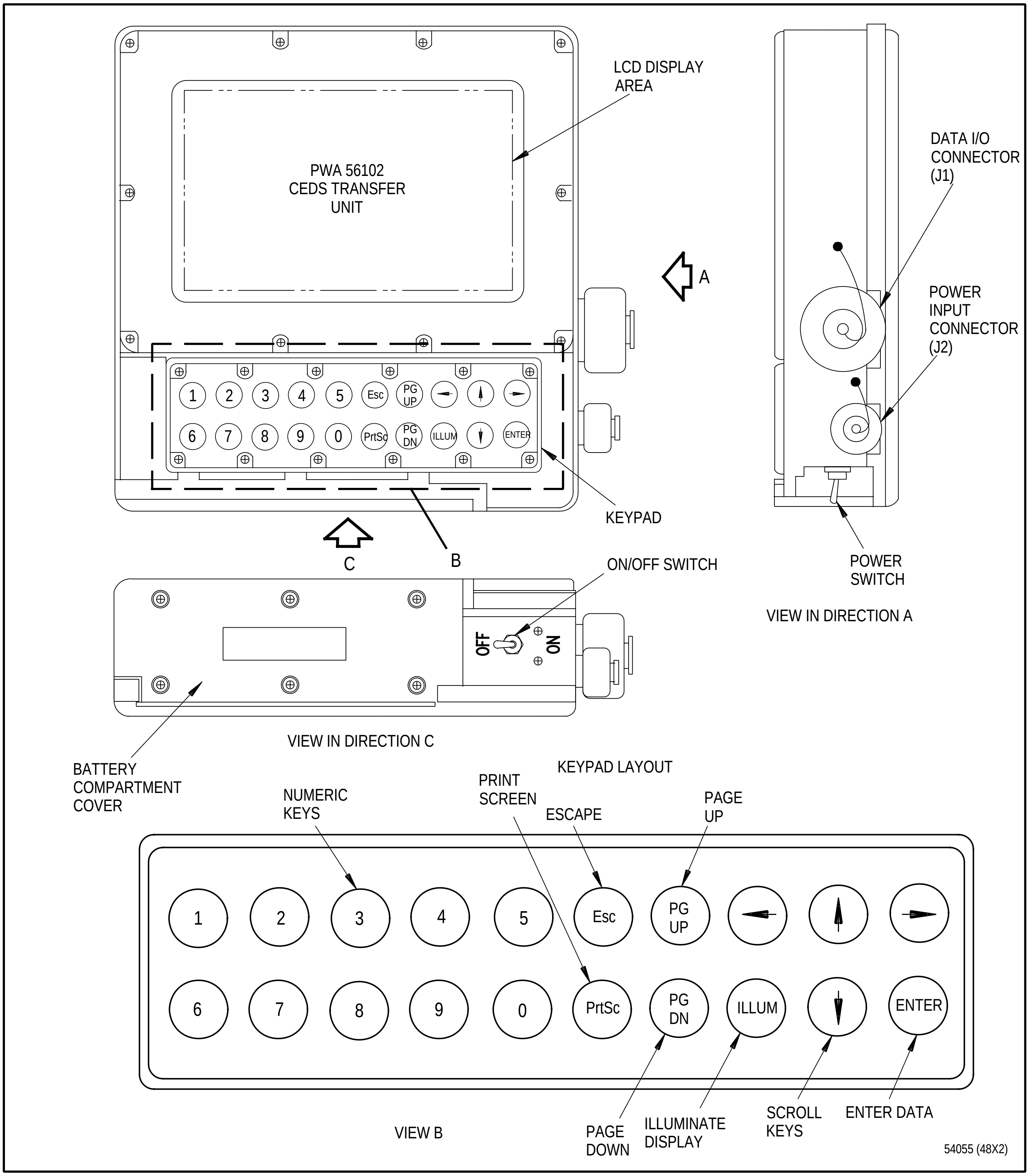


Figure 2. CEDS Transfer Unit

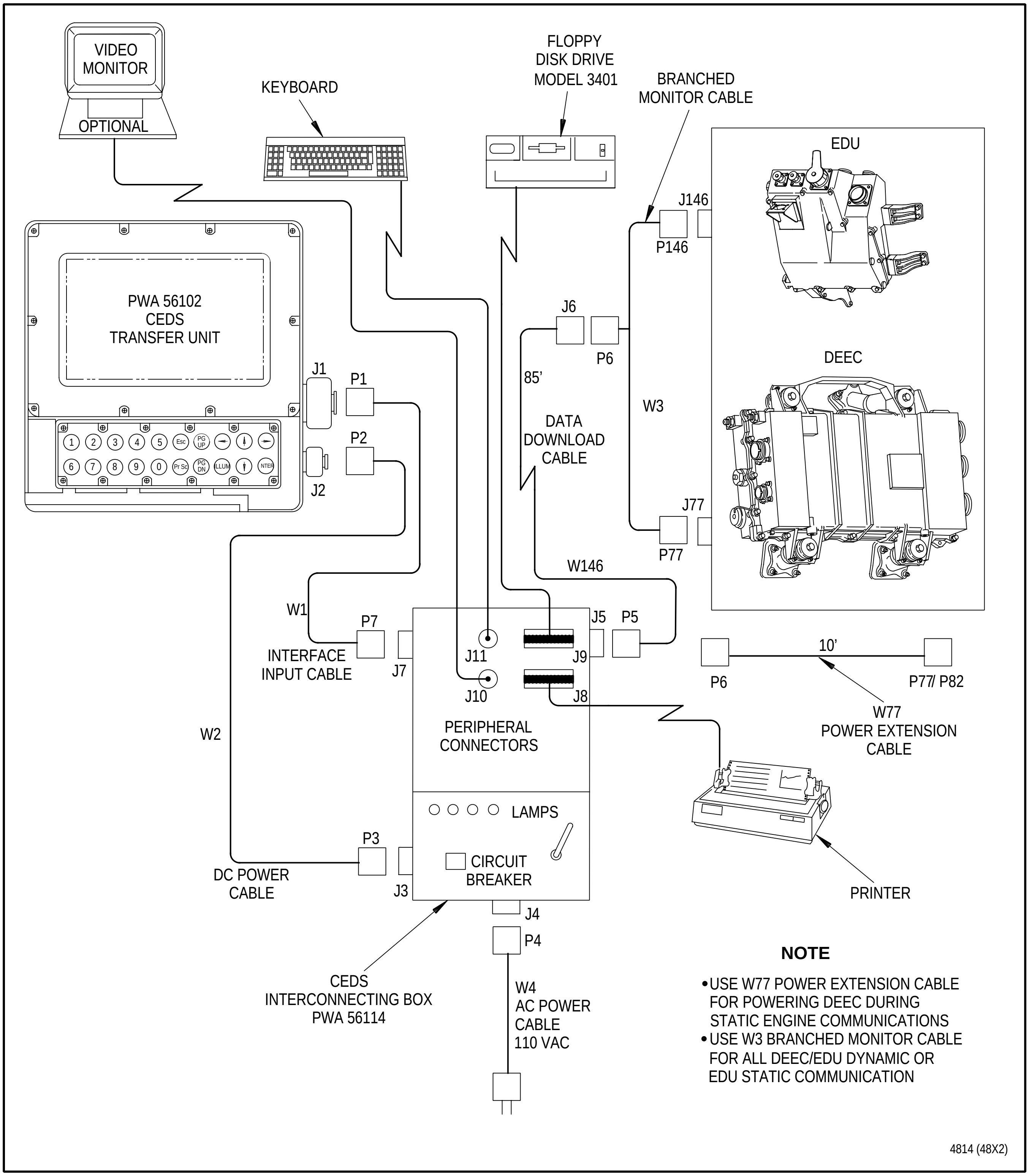


Figure 3. CEDS Communication Cable Connections

3. MODIFY DOCUMENTATION DATA. (See figure 3 and Figure 4.)

NOTE

- Press escape (ESC) key at anytime to return to Main Menu.
- CEDS can be shut off at anytime provided CEDS Transfer Unit displays the Main Menu.
- Press (PrtSc) key to print any screen.

a. Starting with CEDS MAIN MENU, press (0, figure 4.) or select EDU communications then press ENTER.

b. Perform MODIFY EDU DOCUMENTARY DATA as follows:

(1) Press (2) or select MODIFY DOCUMENTARY DATA and press enter.

NOTE

This function is essential for documenting any change part or aircraft/engine change.

(2) Ensure proper cable connections (see figure 3.), press any key to display current modifiable documentation parameters. Once screen is displayed, operator will be prompted to provide new data indicating change to A/C tail number, engine serial number, engine position, EDU serial number, and any serially tracked part. Press enter to keep current value. The (ESC) key can be pressed at any time to return to Main Menu if required, or the (PgUp) key can be pressed to quit data examination and return to EDU main menu.

(3) Following completion of this function CEDS will perform an EDU download to record time/cycle meter reading essential to ETS.

(4) Press ESC key to return to Main Menu.

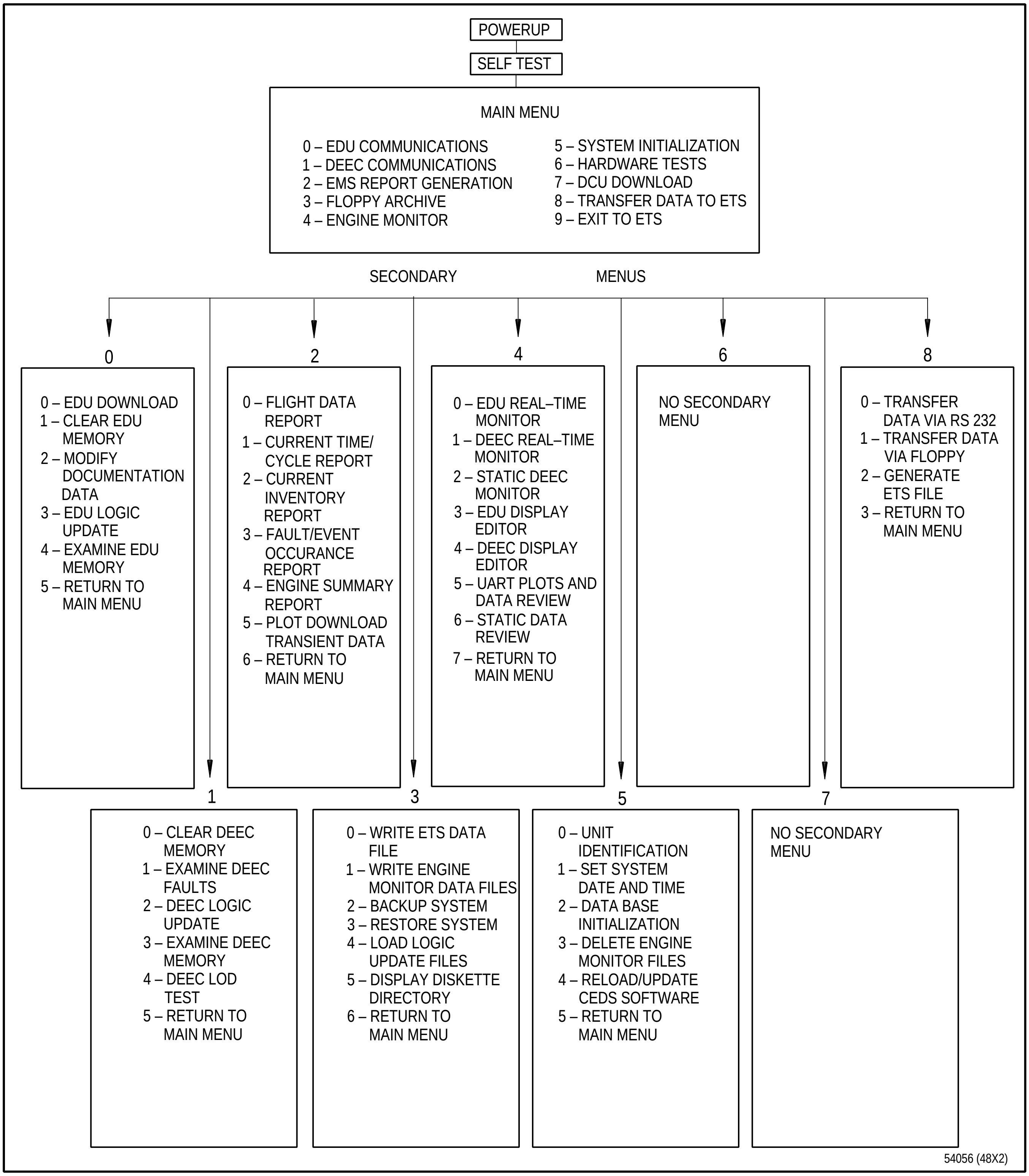


Figure 4. CEDS Operational Flow Chart

4. ERROR MESSAGES.

(See figures 1 through 4.)

NOTE

For the following six Communication Diagnostic ERROR messages, the first line gives an indication of the operation being performed and the second line will give Error number. Although the messages are worded differently, the corrective actions are all the same.

MESSAGE	CORRECTIVE ACTION
Communication Diagnostic ERROR messages are numbered as follows: 1-Timeout on block transfer 2-Block transmission error 3-No. ACK received from EDU/DEEC 4-No handshake with EDU/DEEC 5-Data written/received mismatch 6-SYNC words not found	• Record error message. • Perform Check on Transfer Unit battery/power supply and DSIA cables. Refer to T.O. 33D4-6-745-2. • Retry COMMUNICATIONS. • Perform Transfer Unit HARDWARE TESTS. • Refer to T.O. 31S5-4-2142-2. • Replace Transfer Unit if test fails. Replace DEEC/EDU.
Begin handshake with DCU Sending request for size command Sending request for data command Receiving DCU blocks... Transmission failed - errors detected! Press any key to continue...	• Check cable connections (W7 and W101). • Check DCU battery. • Try again (recycle DCU). • Perform Loop back check (EBIT). Refer to T.O. 31S5-4-2142-2. Replace Transfer Unit if test fails.
Drive not ready (0) Abort, (1) Retry?	• Check floppy drive cable connections. • Check floppy drive to ensure diskette is properly inserted. • Retry. • Replace floppy disk drive
No EDU update files exist! Press any key to continue...	• Update file has been deleted (more than 15 days). Reload files. • Retry disk or try new disk.
Unable to identify correct fault codes.	• Invalid data is present in EDU fault counter registers. • Perform EXAMINE DEEC FAULTS.

MESSAGE	CORRECTIVE ACTION
Performing file integrity checks... Update file integrity checks failed, process aborted! Press any key to continue...	• Reload logic update file.
Performing file integrity checks... EDU EEPROM ID more recent than attempted update, process aborted! Press any key to continue...	• Operator has tried to load an older revision than what the Transfer Unit has stored in memory. Check revision status and reload correct version.
Receiving UART, waiting for valid program identification	• Wait for proper engine N2 RPM (2000) and try again. • Possibility of a bad memory in EDU/ DEEC. Start engine, shut down and restart engine. Replace EDU/DEEC if required.
WARNING: Duplicate engine data, download not stored in data base! ENGSN : 740000 ACTN : 00-0000 EDUSM : BEDU0009 EDU ID : 5-020102 EDU EEPROM : 005 (Typical Data)	• This prevents CEMS IV from getting overloaded with previously stored data.
Error occurred determining the PROGRAM ID Calculated PROGRAM ID does not represent a valid map Press any key to continue...	• Device definition beyond the scope of CEDS. No communications are possible contact SA-ALC/LDAD for assistance.
LOW VOLTAGE FAILURE - CEDS system halted! Internal power monitoring indicates insufficient voltage for system functions. Turn off unit and recharge batteries...	• Recharge batteries or replace with charged batteries.

5. POST-OPERATION PROCEDURES.
(See figures 2 and 3.)

CAUTION

- To prevent possible damage to CEDS and EDU, do not disconnect cables from engine and CEDS J1 and J146 during CEDS/EDU communications.
- To prevent possible damage to transfer unit, turn ICM POWER switch OFF before disconnecting transfer unit from power source.

a. Press ESC key to return to MAIN MENU.

b. Turn ICM POWER switch OFF.

WORK PACKAGE

TECHNICAL PROCEDURES

CLEARING ENGINE FAULTS/EVENTS AND DATA USING CEDS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1	29	10	29	11 - 12	12
2 - 9	12				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Troubleshooting	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
CEDS Transfer Unit	T.O. 31S5-4-2142-2
Diagnostic System Interface Assembly	T.O. 33D4-6-745-2
Comprehensive Engine Diagnostic System (CEDS)	T.O. 33D4-6-746-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

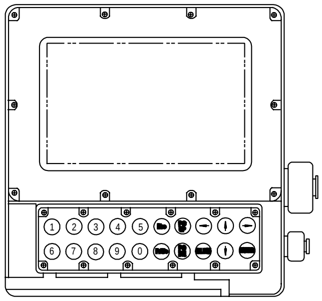
EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

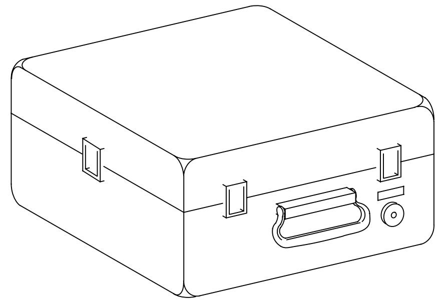
Paragraph	Function - Tool Nomenclature	Tool Number
	CEDS Software	PWA 56091
	Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114
	Floppy Disk Drive	Model/3401 or Equivalent
2	CEDS Set-Up	
3	Clear EDU Memory	
4	Clear DEEC Memory	
5	Error Messages	
6	Post-Operation Procedures	

ILLUSTRATED SUPPORT EQUIPMENT



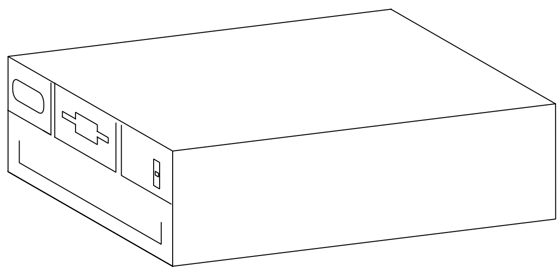
PWA 56102 –C

Figure T1. PWA 56102 Transfer Unit



PWA 56114 –C

Figure T2. PWA 56114 CEDS Interface Assembly



54347

Figure T3. Model/3401 Floppy Disk Drive

1. INTRODUCTION.

a. This work package contains procedures to clear EDU and DEEC fault, events, and data using the Comprehensive Engine Diagnostic System (CEDS) (PWA 56091 software, PWA 56102 transfer unit, and PWA 56114 Diagnostic System Interface Assembly - DSIA).

b. Fault/event codes are generated by the EDU and DEEC. DEEC-generated codes are sent to the EDU for storage. DEEC automatically clears its codes on engine start to avoid duplication. If the DEEC is suspected of not being cleared after engine start, use this procedure to clear DEEC memory.

c. The option to clear the EDU is available after routine data downloading into CEDS. Do not clear EDU if faults or events occur. The fault/event codes must be preserved for engine troubleshooting. However, the EDU must be cleared before the next engine run to prevent fault/event codes from recurring. This procedure is used to clear the EDU after troubleshooting is completed.

d. When clearing an EDU, only pointers identifying data are erased. Actual engine data is never erased, but later overwritten. Pointers identify valid data, and CEDS will only display relevant data for downloading.

e. Deleted.

2. CEDS SET-UP.
(See Figures 1, 2, and 3.)

a. Figure 1 shows communication between elements of Engine Monitoring System(EMS).
Figure 2 shows CEDS Transfer Unit.
Figure 3 shows CEDS communication cable connections.
Prepare CEDS for use. Refer to T.O. 33D4-6-746-1 and T.O. 31S5-4-2142-2.

CAUTION

To prevent erroneous operation, ensure J1, J77 or J82, and J146 are connected through proper cables between engine and CEDS before attempting CEDS/EDU/DEEC communications.

b. Turn Interconnection Module (ICM) computer POWER switch ON.

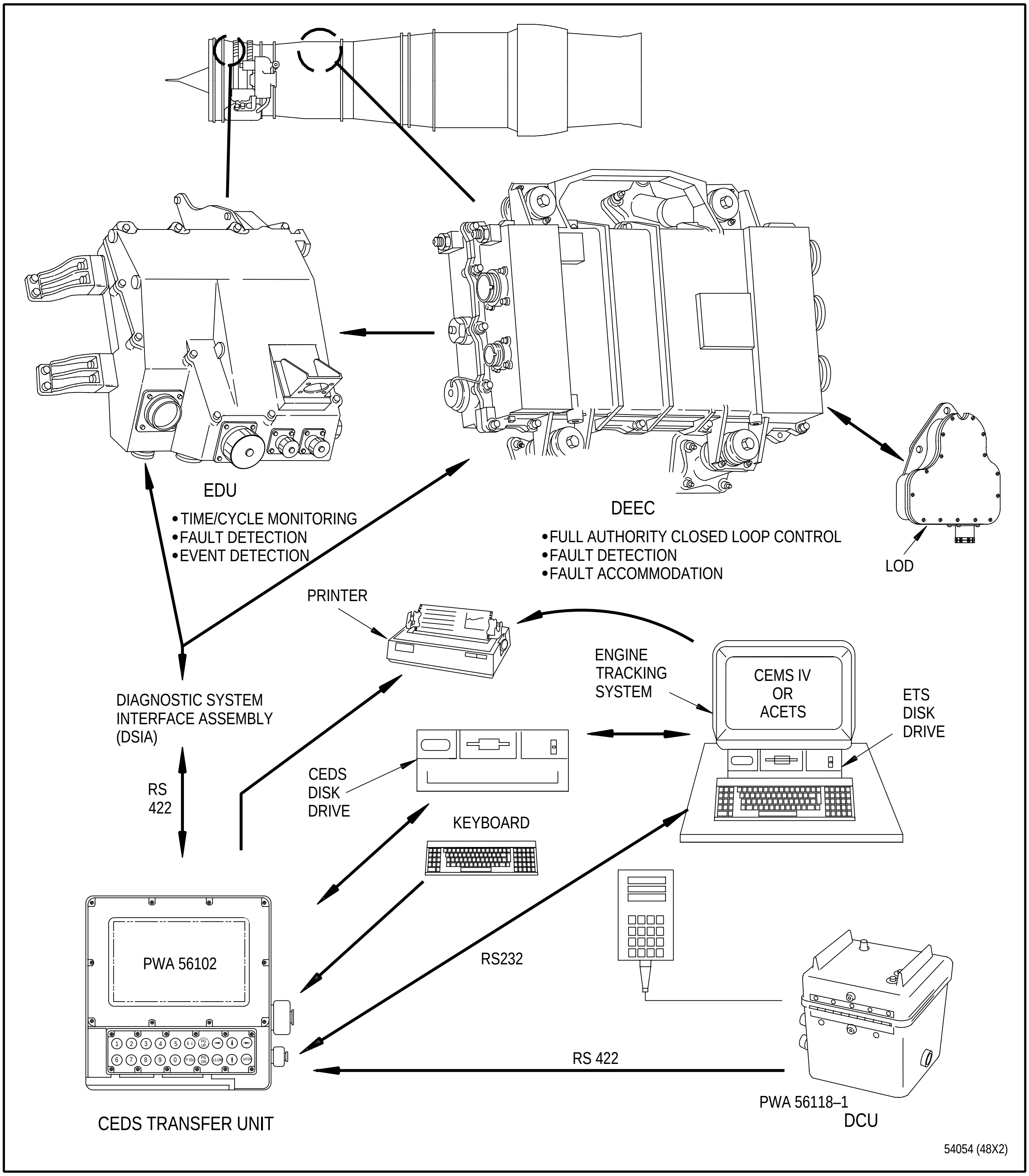


Figure 1. Engine Monitoring System

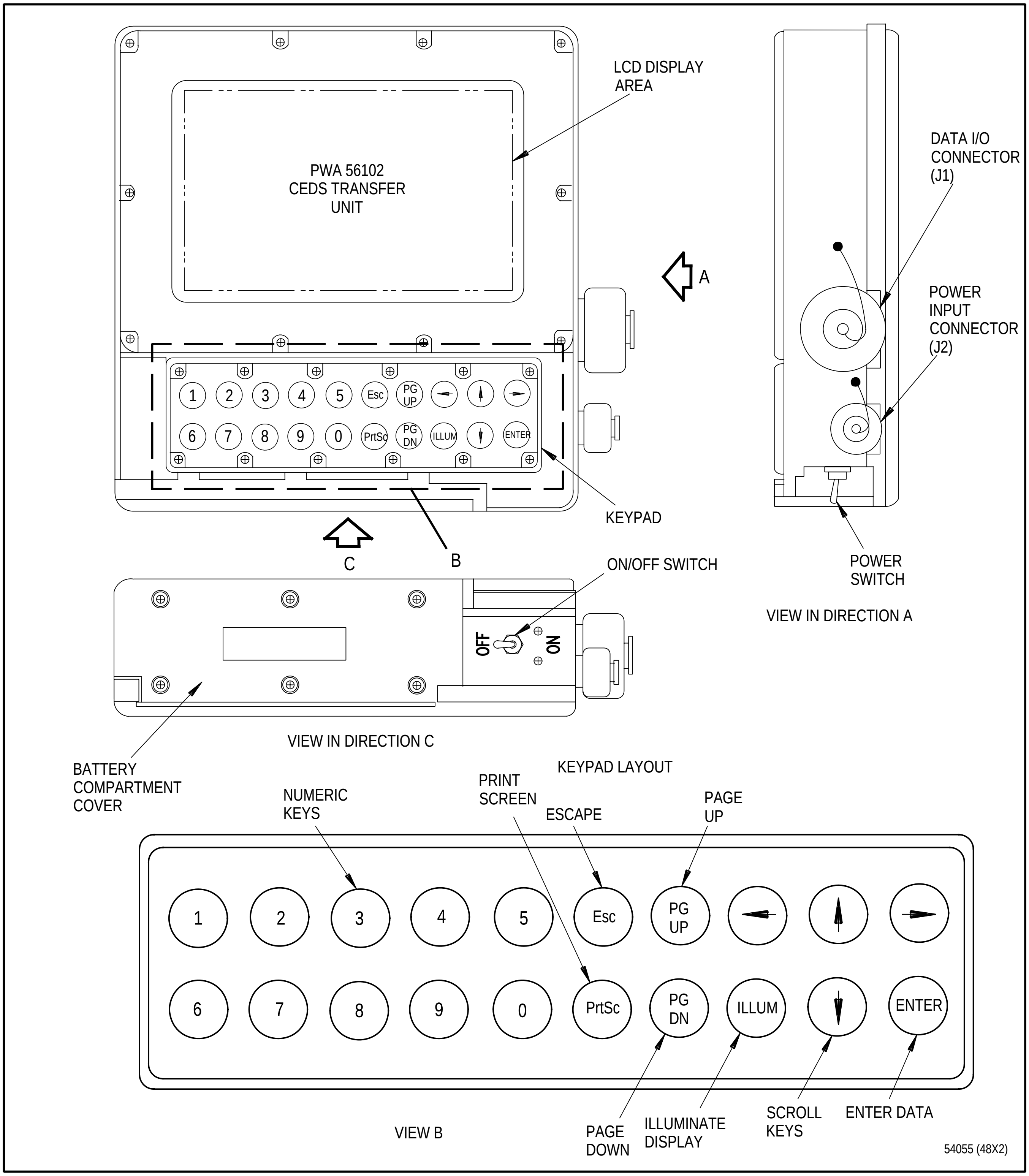


Figure 2. CEDS Transfer Unit

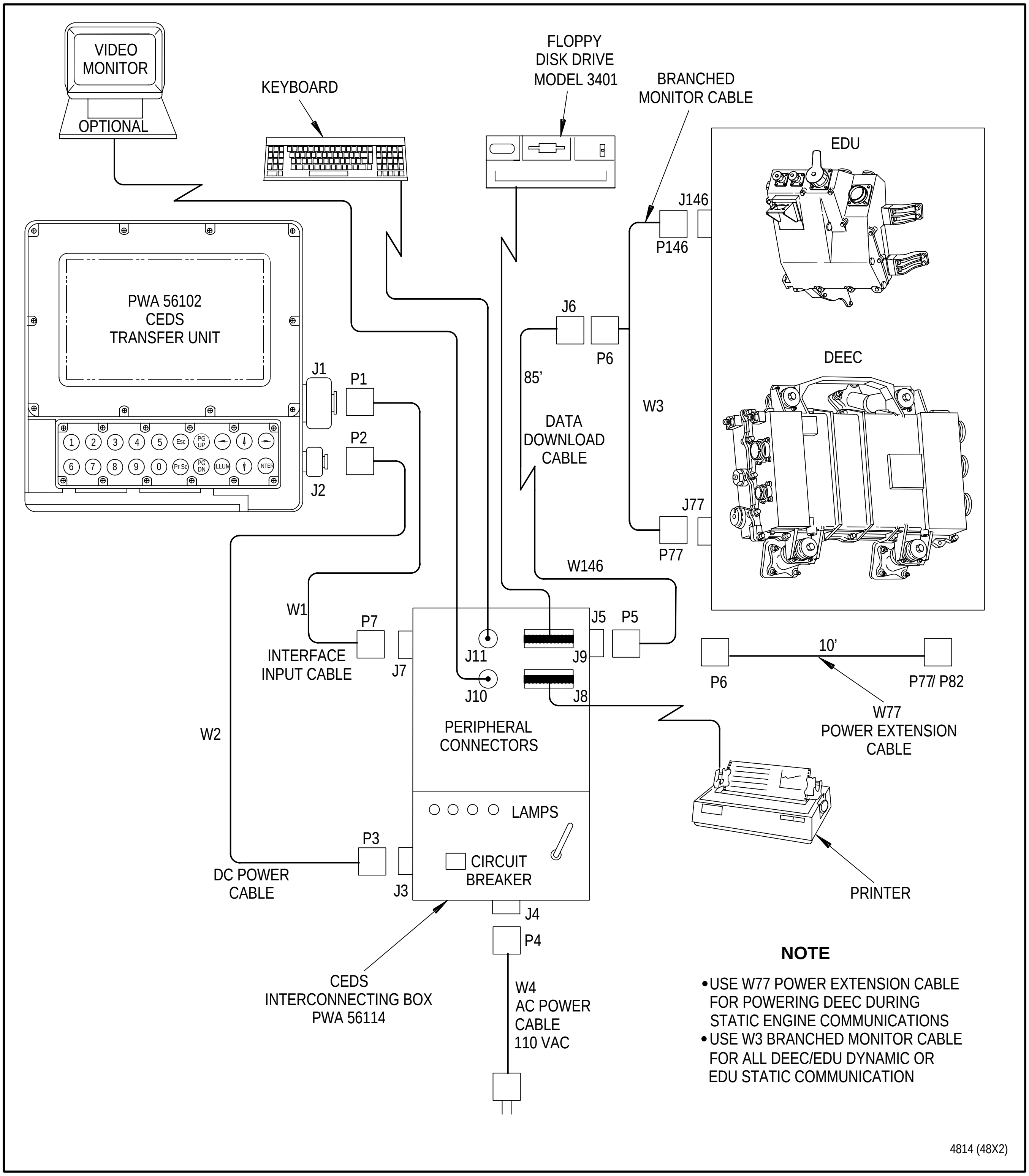


Figure 3. CEDS Communication Cable Connections

3. CLEAR EDU MEMORY

(See figures 2, 3, and Figure 4.)

NOTE

- Press escape (ESC) key at any time to return to Main Menu.
- CEDS can be shut off at any time provided CEDS Transfer Unit displays the Main Menu.
- Press (PrtSc) key to print any screen.

a. Starting with CEDS MAIN MENU, press (0, figure 4.) to select EDU COMMUNICATIONS then press ENTER.

b. Perform CLEAR EDU MEMORY as follows:

(1) Press (1) or select CLEAR EDU MEMORY and press ENTER.

(2) Ensure proper cable connections (see figure 2 and 3), press any key to CLEAR EDU MEMORY. Screen will display clearing EDU EEPROM. . .Completed.

(3) Press ESC key to return to Main Menu.

4. CLEAR DEEC MEMORY.

(See figures 2, 3, and 4.)

NOTE

- Press escape (ESC) key at any time to return to Main Menu.
- CEDS can be shut off at any time provided CEDS Transfer Unit displays the Main Menu.
- Press (PrtSc) key to print any screen.

a. Starting with CEDS MAIN MENU, press (1, figure 4.) to select DEEC COMMUNICATIONS and press ENTER.

b. Perform CLEAR DEEC MEMORY as follows:

(1) Press (0) or select CLEAR DEEC MEMORY and press ENTER.

CAUTION

To prevent damage to CEDS and DEEC do not start engine with W77 power extension cable installed.

(2) Ensure proper cable connections (see figure 2 and 3), press any key to CLEAR DEEC MEMORY.

(3) Press ESC key to return to Main Menu.

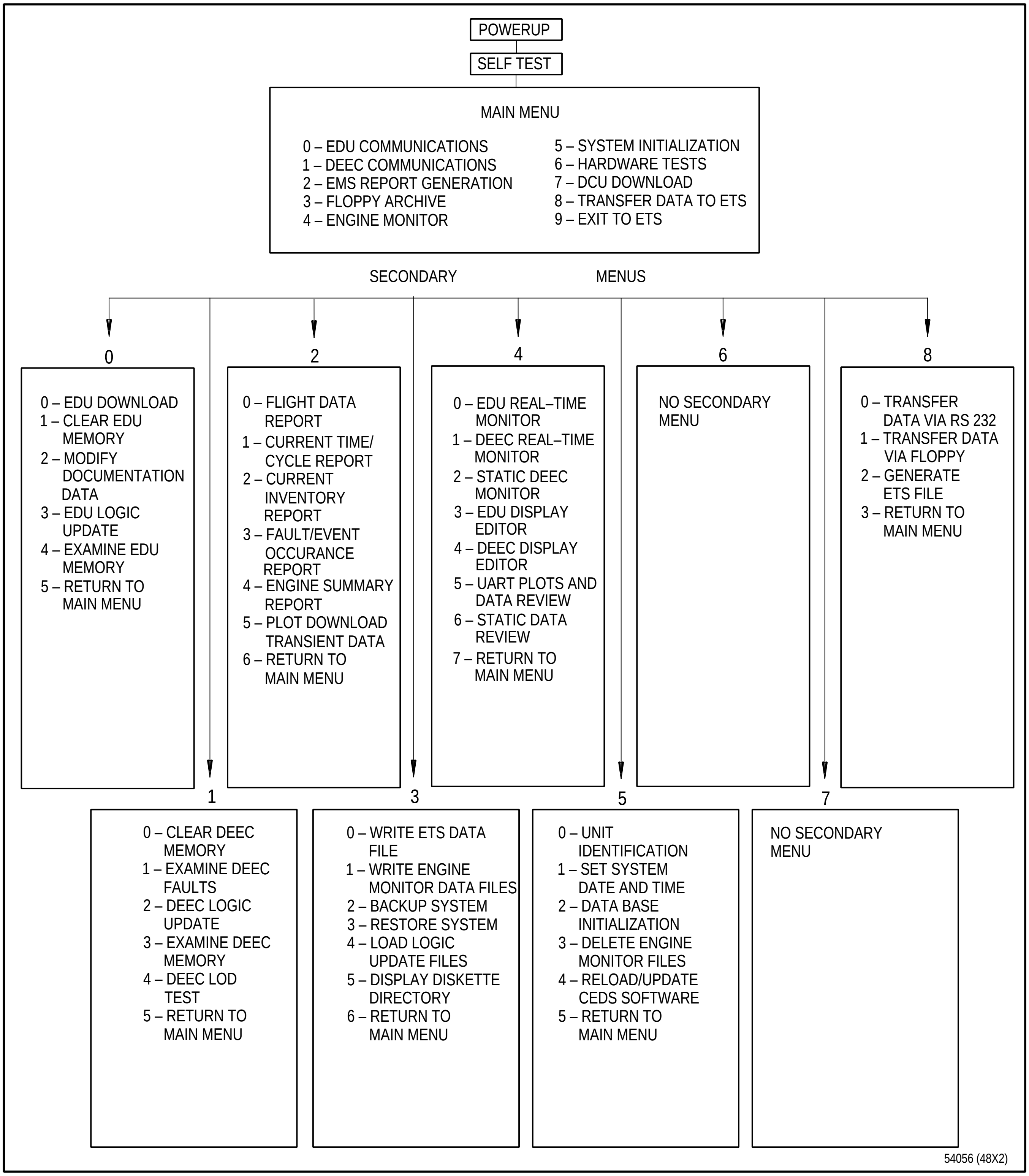


Figure 4. CEDS Operational Flow Chart

5. ERROR MESSAGES.

(See figures 1 through 4.)

CAUTION

Use of damaged support equipment or cables may cause damage to LRU.

a. Inspect support equipment and cables prior to replacement of LRU or Transfer Unit. Refer to T.O. 33D4-6-745-2.

NOTE

For the following six Communication Diagnostic ERROR messages, the first line gives an indication of the operation being performed and the second line will give Error number. Although the messages are worded differently, the corrective actions are all the same.

MESSAGE	CORRECTIVE ACTION
Communication Diagnostic ERROR messages are numbered as follows: 1-Timeout on block transfer 2-Block transmission error 3-No.ACK received from EDU/DEEC 4-No handshake with EDU/DEEC 5-Data written/received mismatch 6-SYNC words not found	Perform corrective action in the order shown as follows: • Record error message. • Perform Check on Transfer Unit battery/ power supply pin to pin and check on DSIA cables in a flexed position. Refer to T.O. 33D4-6-745-2. Replace cables if tests fail. • Retry COMMUNICATIONS. • Perform CEDS HARDWARE TESTS. Refer to T.O. 31S5-4-2142-2. Replace Transfer Unit if test fails. • Replace DEEC/EDU.
Begin handshake with DCU Sending request for size command Sending request for data command Receiving DCU blocks... Transmission failed - errors detected! Press any key to continue...	• Check cable connections (W7 and W101). • Check DCU battery. • Try again (recycle DCU). • Perform Loop back check (EBIT). Refer to T.O. 31S5-4-2142-2. Replace Transfer Unit if test fails.
Drive not ready (0) Abort, (1) Retry?	• Check floppy drive cable connections. • Check floppy drive to ensure diskette is properly inserted. • Retry. • Replace floppy disk drive
No EDU update files exist! Press any key to continue...	• Update file has been deleted (more than 15 days). Reload files. • Retry disk or try new disk.
Unable to identify correct fault codes.	• Invalid data is present in EDU fault counter registers. • Perform EXAMINE DEEC FAULTS.

MESSAGE	CORRECTIVE ACTION
Performing file integrity checks... Update file integrity checks failed, process aborted! Press any key to continue...	• Reload logic update file.
Performing file integrity checks... EDU EEPROM ID more recent than attempted update, process aborted! Press any key to continue...	• Operator has tried to load an older revision than what the Transfer Unit has stored in memory. Check revision status and reload correct version.
Receiving UART, waiting for valid program identification	• Wait for proper engine N2 RPM (2000) and try again. • Possibility of a bad memory in EDU/DEEC. Start engine, shut down and restart engine. Replace EDU/DEEC if required.
WARNING: Duplicate engine data, download not stored in data base! ENGSN : 740000 ACTN : 00-0000 EDUSM : BEDU0009 EDU ID : 5-020102 EDU EEPROM : 005 (Typical Data)	• This prevents CEMS IV from getting overloaded with previously stored data.
Error occurred determining the PROGRAM ID Calculated PROGRAM ID does not represent a valid map Press any key to continue...	• Device definition beyond the scope of CEDS. If no communications are possible, contact SA-ALC/LDAD for assistance.
LOW VOLTAGE FAILURE - CEDS system halted! Internal power monitoring indicates insufficient voltage for system functions. Turn off unit and recharge batteries...	• Recharge batteries or replace with charged batteries.

6. POST-OPERATION PROCEDURES. (See figure.)

CAUTION

- To prevent possible damage to CEDS, EDU, and DEEC, do not disconnect cables from engine and CEDS J1, J77 or J82, and J146 during CEDS/EDU/DEEC communications.
- To prevent possible damage to transfer unit, turn ICM POWER switch OFF before disconnecting transfer unit from power source.

a. Press ESC key to return to MAIN MENU.

b. Turn ICM POWER switch OFF.

WORK PACKAGE

TECHNICAL PROCEDURES

UPLOADING DATA TO ENGINE TRACKING SYSTEMS USING CEDS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 14

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 10	12	11 - 13 Added	12	14 Blank Added	0

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Troubleshooting	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
CEDS Transfer Unit	T.O. 31S5-4-2142-2
Diagnostic System Interface Assembly	T.O. 33D4-6-745-2
Comprehensive Engine Diagnostic System (CEDS)	T.O. 33D4-6-746-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

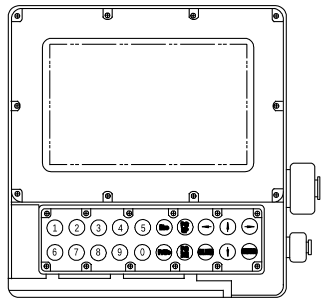
EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

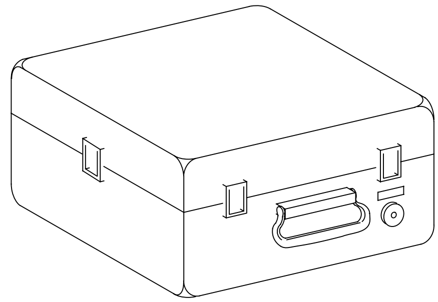
Paragraph	Function - Tool Nomenclature	Tool Number
	CEDS Software	PWA 56091
	Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114
	Floppy Disk Drive	Model/3401 or Equivalent
2	CEDS Set-Up	
3	Transfer Data to ETS	
4	Error Messages	
5	Post-Operation Procedures	

ILLUSTRATED SUPPORT EQUIPMENT



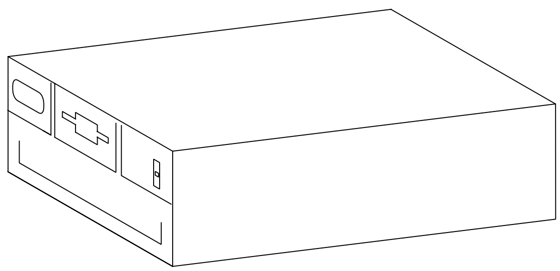
PWA 56102 –C

Figure T1. PWA 56102 Transfer Unit



PWA 56114 –C

Figure T2. PWA 56114 CEDS Interface Assembly



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Figure T3. Model/3401 Floppy Disk Drive

1. INTRODUCTION.

a. This work package contains procedures to upload data from Comprehensive Engine Diagnostic System (CEDS) (PWA 56091 software, PWA 56102 transfer unit and serial communications cable, and PWA 56114 Diagnostic System Interface Assembly - DSIA) to Engine Tracking System (ETS).

b. Transfer Data to ETS menu option allows transfer of a CEDS-created ETS data file (CEDS2CEMS.DAT) to an engine tracking system. This may be CEMS IV or ACETS. Once transferred, CEDS will automatically delete the transfer file from it’s memory to prevent duplicate data transfer. This option also allows generation of CEDS2CEMS.DAT file consisting of all ETS data stored in CEDS in case ETS data is corrupted in CEMS IV or ACETS. The menu options are as follows:

(1) Transfer data via RS-232:

(a) This menu option requires operator to connect CEDS to the tracking computer through a cable connection. Data transfer software must be activated in the receiving computer before transfer can be performed. Operator will then transfer information contained in CEDS (CEDS2CEMS.DAT) to tracking system. CEDS2CEMS.DAT file is automatically deleted after data transfer.

(2) Transfer data via floppy:

(a) This menu option allows operator to transfer information contained in CEDS (CEDS2CEMS.DAT) to a floppy disk, so the floppy disk can be eventually loaded into tracking system. CEDS2CEMS.DAT file is automatically deleted after transfer to floppy.

(3) Generate ETS file:

(a) This menu option allows operator to generate ETS file consisting of all ETS data on CEDS. All ETS data on CEDS, including data previously transferred, is included on CEDS2CEMS.DAT file. This option should only be used in case of data corruption in CEMS IV or ACETS. Data must be transferred to ETS using one of options above.

c. Exit to ETS aborts CEDS software execution and returns computer control to the calling program.

d. Deleted.

e. Deleted.

2. CEDS SET-UP.

(See Figures 1, 2, and 3.)

a. Figure 1 shows communication between elements of Engine Monitoring System (EMS).
Figure 2 shows CEDS Transfer Unit.
Figure 3 shows CEDS communication cable connections.
Prepare CEDS for use. Refer to T.O. 33D4-6-746-1 and T.O. 31S5-4-2142-2

CAUTION

To prevent erroneous uploading, ensure correct cable connections between CEDS computer J1 and ETS peripherals before data uploading.

b. Turn Interconnection Module (ICM) computer POWER switch ON.

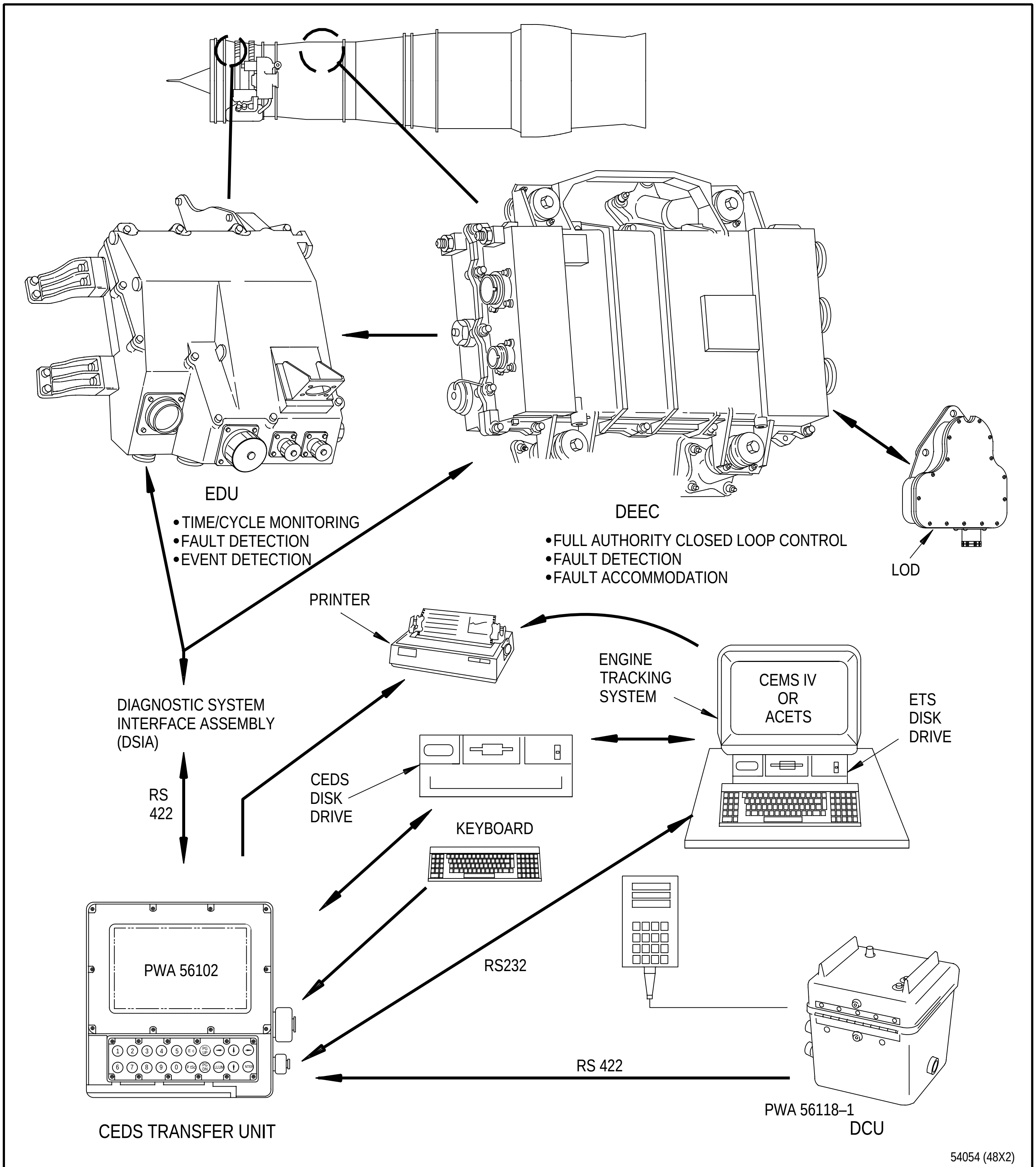


Figure 1. Engine Monitoring System

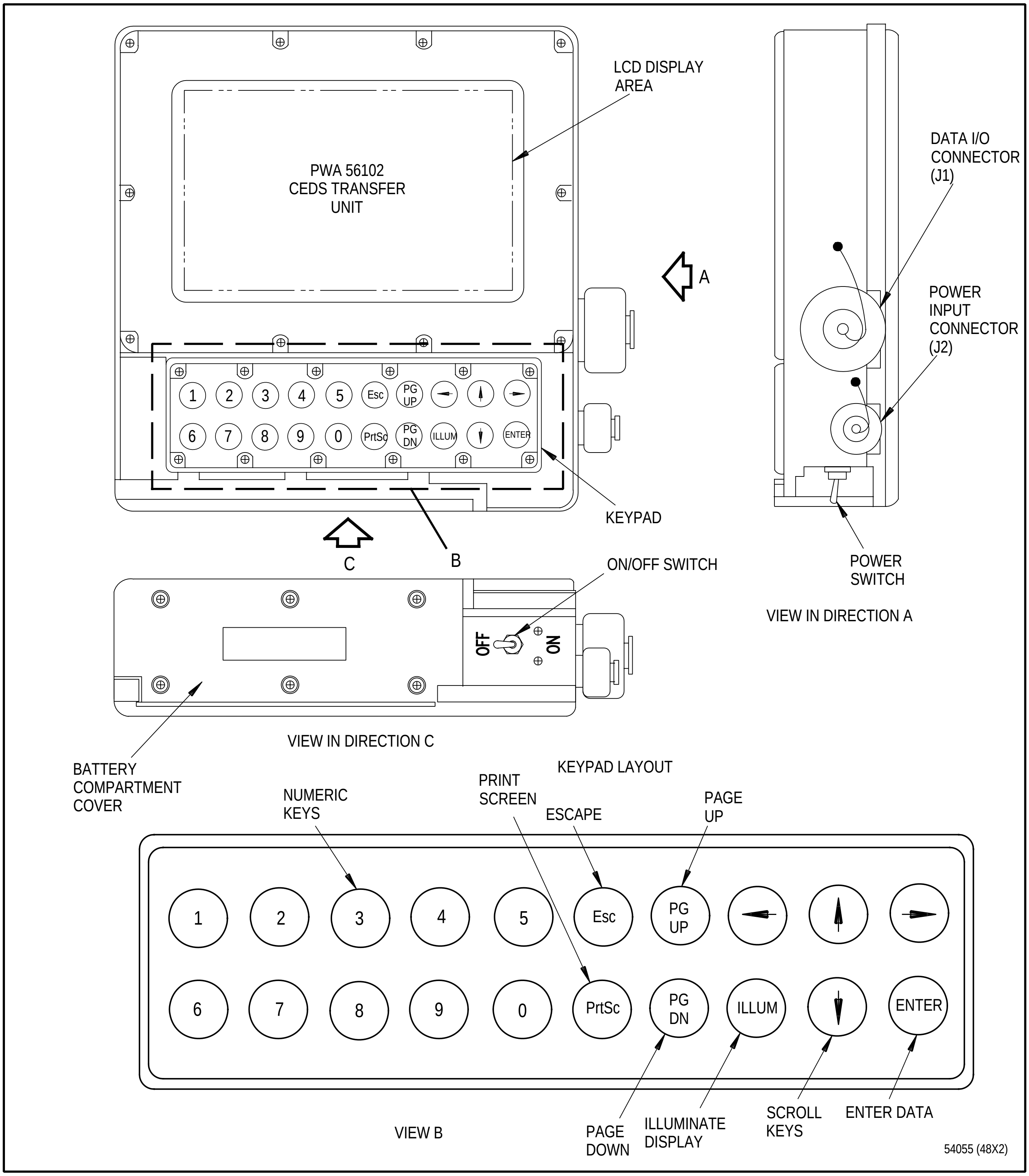


Figure 2. CEDS Transfer Unit

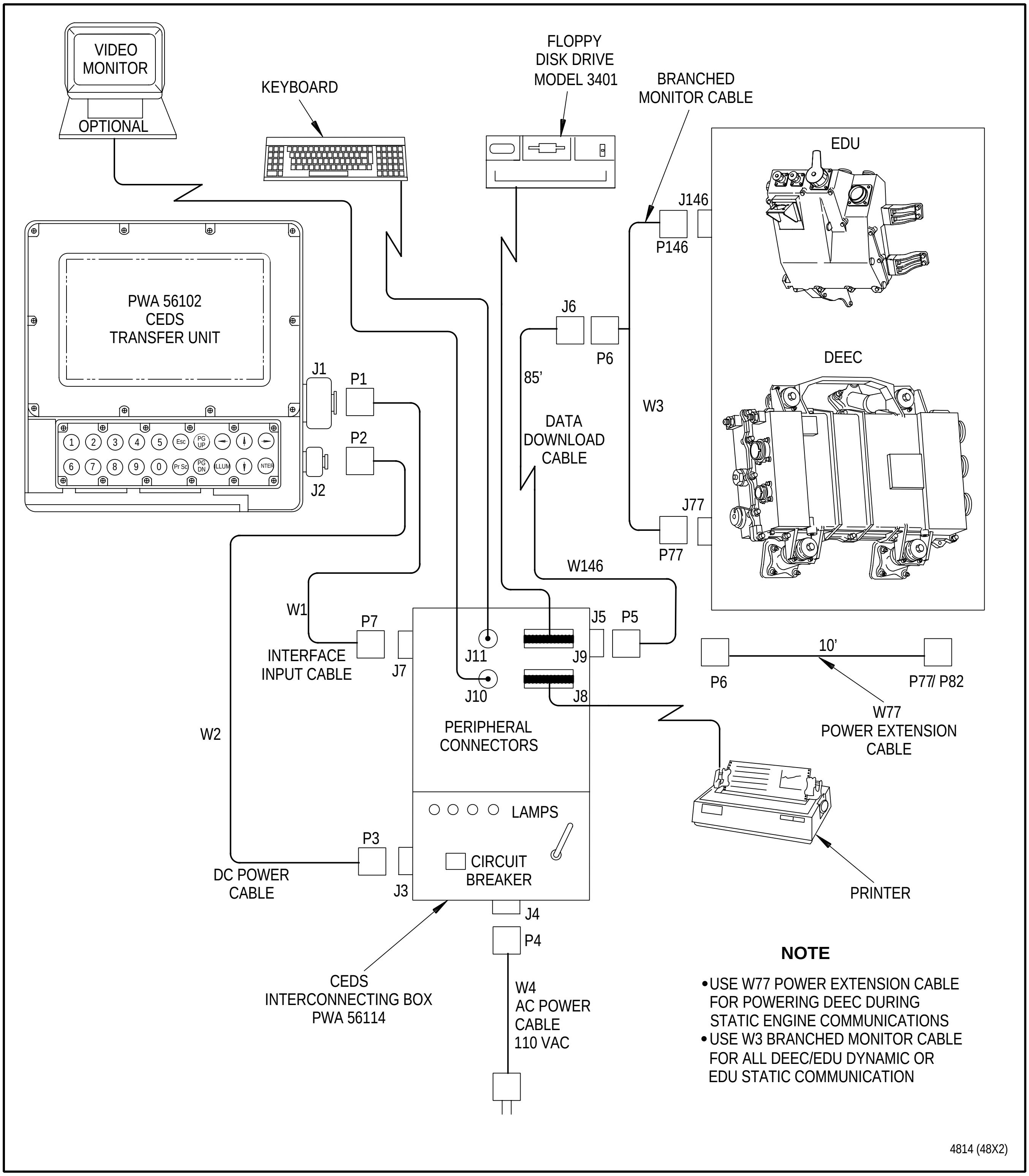


Figure 3. CEDS Communication Cable Connections

3. TRANSFER DATA TO ETS.
(See figures 2, 3, and Figure 4.)

a. Starting with CEDS MAIN MENU, press (8) or select TRANSFER DATA TO ETS then press ENTER.

b. Perform TRANSFER DATA TO ETS as follows:

(1) Select (0, figure 4.) TRANSFER DATA via RS-232 or (1) TRANSFER DATA VIA FLOPPY to transfer data to ETS.

(a) Perform TRANSFER DATA VIA RS-232 transfer as follows:

1 Ensure RS-232 communication cable is connected to the ETS (see figures 2 and 3.).

2 Ensure CEDS receiving program is loaded and waiting on the receiving computer.

NOTE

The engine data will be erased from CEDS memory after file transmission is completed.

3 Press ENTER to initiate CEDS to ETS serial data transfer.

NOTE

CEDS must be depowered before floppy disk can be connected and recognized.

(b) Perform TRANSFER DATA VIA FLOPPY as follows:

1 Ensure CEDS floppy disk drive is installed to the interconnecting box.

2 Install disk into floppy drive.

NOTE

Existing data on floppy will be erased during file transmission.

3 Press ENTER to initiate CEDS to ETS serial data transfer.

(2) Press ESC key to return to Main Menu.

c. Perform GENERATE ETS FILE as follows:

NOTE

GENERATE ETS FILE should only be used if engine tracking system (ACETS or CEMS IV) fails to receive data in above procedures and data is lost.

(1) Select (2) GENERATE ETS FILE.

(2) Press ENTER to initiate ETS file generation.

(3) Transfer data to ETS using one of above options.

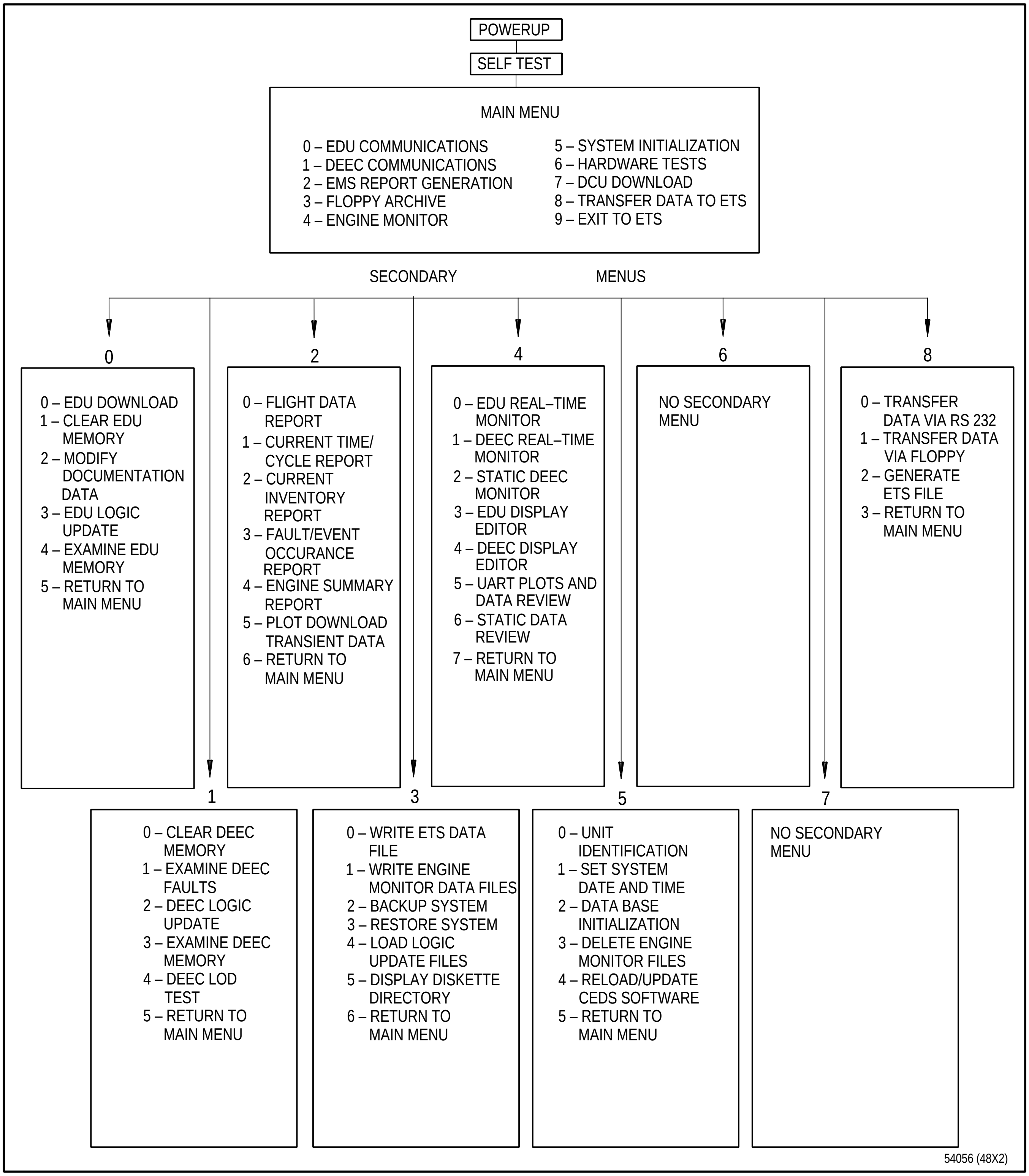


Figure 4. CEDS Operational Flow Chart

4. ERROR MESSAGES.

(See figures 2, 3, and 4.)

NOTE

For the following six Communication Diagnostic ERROR messages, the first line gives an indication of the operation being performed and the second line will give Error number. Although the messages are worded differently, the corrective actions are all the same.

MESSAGE	CORRECTIVE ACTION
Communication Diagnostic ERROR messages are numbered as follows: 1-Timeout on block transfer 2-Block transmission error 3-No. ACK received from EDU/DEEC 4-No handshake with EDU/DEEC 5-Data written/received mismatch 6-SYNC words not found	• Record error message. • Perform Check on Transfer Unit battery/power supply and DSIA cables. Refer to T.O. 33D4-6-745-2. • Retry COMMUNICATIONS. • Perform Transfer Unit HARDWARE TESTS. Refer to T.O. 31S5-4-2142-2. Replace Transfer Unit if test fails. • Replace DEEC/EDU.
Begin handshake with DCU Sending request for size command Sending request for data command Receiving DCU blocks... Transmission failed - errors detected! Press any key to continue...	• Check cable connections (W7 and W101). • Check DCU battery. • Try again (recycle DCU). • Perform Loop back check (EBIT). Refer to T.O. 31S5-4-2142-2. Replace Transfer Unit if test fails.
Drive not ready (0) Abort, (1) Retry?	• Check floppy drive cable connections. • Check floppy drive to ensure diskette is properly inserted. • Retry. • Replace floppy disk drive
No EDU update files exist! Press any key to continue...	• Update file has been deleted (more than 15 days). Reload files. • Retry disk or try new disk.
Unable to identify correct fault codes.	• Invalid data is present in EDU fault counter registers. • Perform EXAMINE DEEC FAULTS.

MESSAGE	CORRECTIVE ACTION
Performing file integrity checks... Update file integrity checks failed, process aborted! Press any key to continue...	• Reload logic update file.
Performing file integrity checks... EDU EEPROM ID more recent than attempted update, process aborted! Press any key to continue...	• Operator has tried to load an older revision than what the Transfer Unit has stored in memory. Check revision status and reload correct version.
Receiving UART, waiting for valid program identification	• Wait for proper engine N2 RPM (2000) and try again. • Possibility of a bad memory in EDU/ DEEC. Start engine, shut down and restart engine. Replace EDU/DEEC if required.
WARNING: Duplicate engine data, download not stored in data base! ENGSN : 740000 ACTN : 00-0000 EDUSM : BEDU0009 EDU ID : 5-020102 EDU EEPROM : 005 (Typical Data)	• This prevents CEMS IV from getting overloaded withpreviously stored data.
Error occurred determining the PROGRAM ID Calculated PROGRAM ID does not represent a valid map Press any key to continue...	• Device definition beyond the scope of CEDS. If no communications are possible, contact SA-ALC/LDAD for assistance.
LOW VOLTAGE FAILURE - CEDS system halted! Internal power monitoring indicates insufficient voltage for system functions. Turn off unit and recharge batteries...	• Recharge batteries or replace with charged batteries.

5. POST-OPERATION PROCEDURES.

(See figures 2 and 3.)

CAUTION

- To prevent possible damage to CEDS and peripherals, do not disconnect cables during data uploading.
- To prevent possible damage to transfer unit, turn ICM POWER switch OFF before disconnecting transfer unit from power source.

a. Press ESC key to return to MAIN MENU.

b. Turn ICM computer POWER switch OFF.

WORK PACKAGE

TECHNICAL PROCEDURES

REVISING EDU AND DEEC SOFTWARE USING CEDS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 16

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 12	12	13 - 15 Added	12	16 Blank Added	0

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Troubleshooting	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
CEDS Transfer Unit	T.O. 31S5-4-2142-2
Diagnostic System Interface Assembly	T.O. 33D4-6-745-2
Comprehensive Engine Diagnostic System (CEDS)	T.O. 33D4-6-746-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

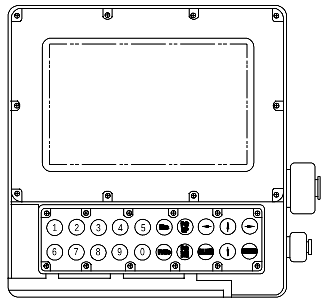
EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

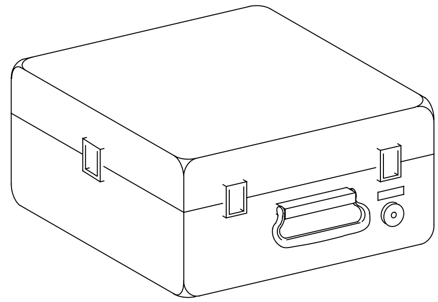
Paragraph	Function - Tool Nomenclature	Tool Number
	CEDS Software	PWA 56091
	Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114
	Floppy Disk Drive	Model/3401 or Equivalent
2	CEDS Set-Up	
3	Load Logic Update	
4	EDU Logic Update	
5	DEEC Logic Update	
6	Error Messages	
7	Post-Operation Procedures	

ILLUSTRATED SUPPORT EQUIPMENT



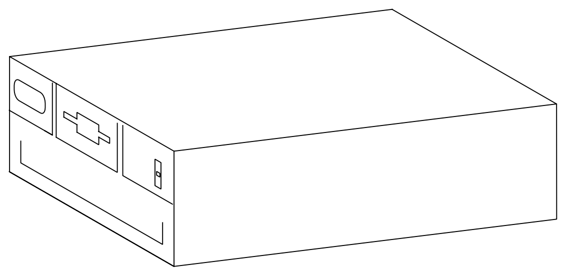
PWA 56102 –C

Figure T1. PWA 56102 Transfer Unit



PWA 56114 –C

Figure T2. PWA 56114 CEDS Interface Assembly



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Figure T3. Model/3401 Floppy Disk Drive

1. INTRODUCTION.

a. This work package contains procedures to revise EDU and DEEC software using the Comprehensive Engine Diagnostic System (CEDS) (PWA 56091 software PWA 56102 transfer unit, and PWA 56114 Diagnostic System Interface - DSIA).

b. EDU and DEEC software revisions are performed when authorized by a Time Compliance Technical Order (TCTO). A floppy disk containing the revised codes will accompany the TCTO. Software revisions are accomplished by uploading the revision codes into EDU/DEEC Electrically Erasable Programmable Read-Only Memory (EEPROM).

c. The revision procedure is done in two steps: 1. Revision codes are uploaded from the floppy disk to the CEDS computer memory and 2. the revised data is uploaded to the EDU/DEEC memory.

d. Installed engine software revisions include changes to EDU/DEEC adjustments and parameters used during EDU/DEEC operation. However, EDU/DEEC operating programs are not changed. Changes to EDU/DEEC operating programs require the component(s) to be removed from the engine and their internal board circuits modified.

e. The EDU/DEEC EEPROM ID, displayed with the documentary data during normal EDU downloading, will be revised. However, changes to the EDU/DEEC program ID will not occur with this procedure.

f. Deleted.

2. CEDS SET-UP.
(See Figures 1, 2, and 3.)

a. Figure 1 shows communication between elements of Engine Monitoring System (EMS). Figure 2 shows CEDS Transfer Unit. Figure 3 shows CEDS/EDU/DEEC software revision, data upload cable connections. Prepare CEDS for use. Refer to T.O. 33D4-6-746-1 and T.O. 31S5-4-2142-2.

CAUTION

To prevent erroneous operation, ensure J1, J77 or J82, and J146 are connected through proper cables between engine and CEDS before attempting CEDS/EDU/DEEC communications.

b. Turn Interconnection Module (ICM) computer POWER switch ON.

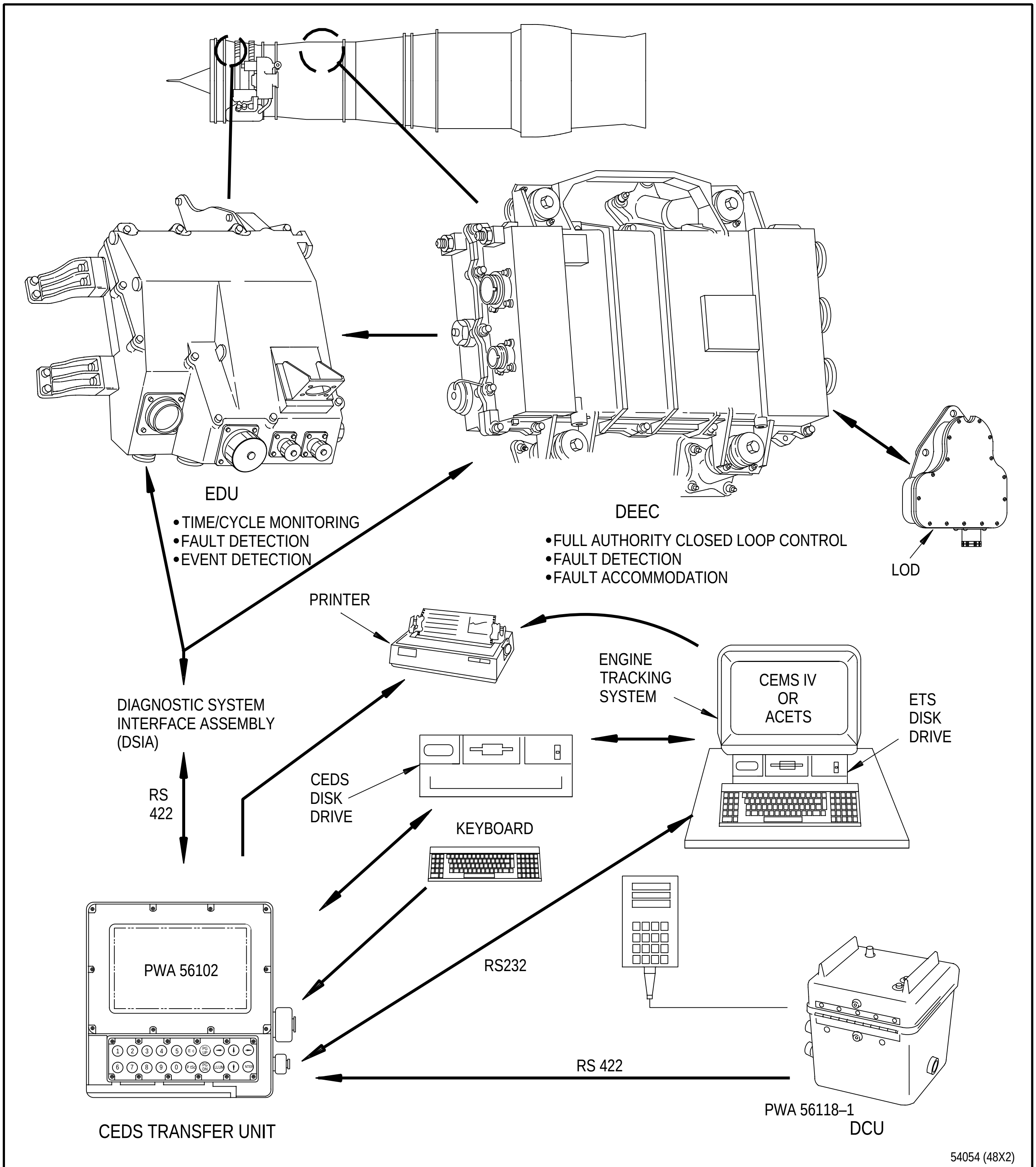


Figure 1. Engine Monitoring System

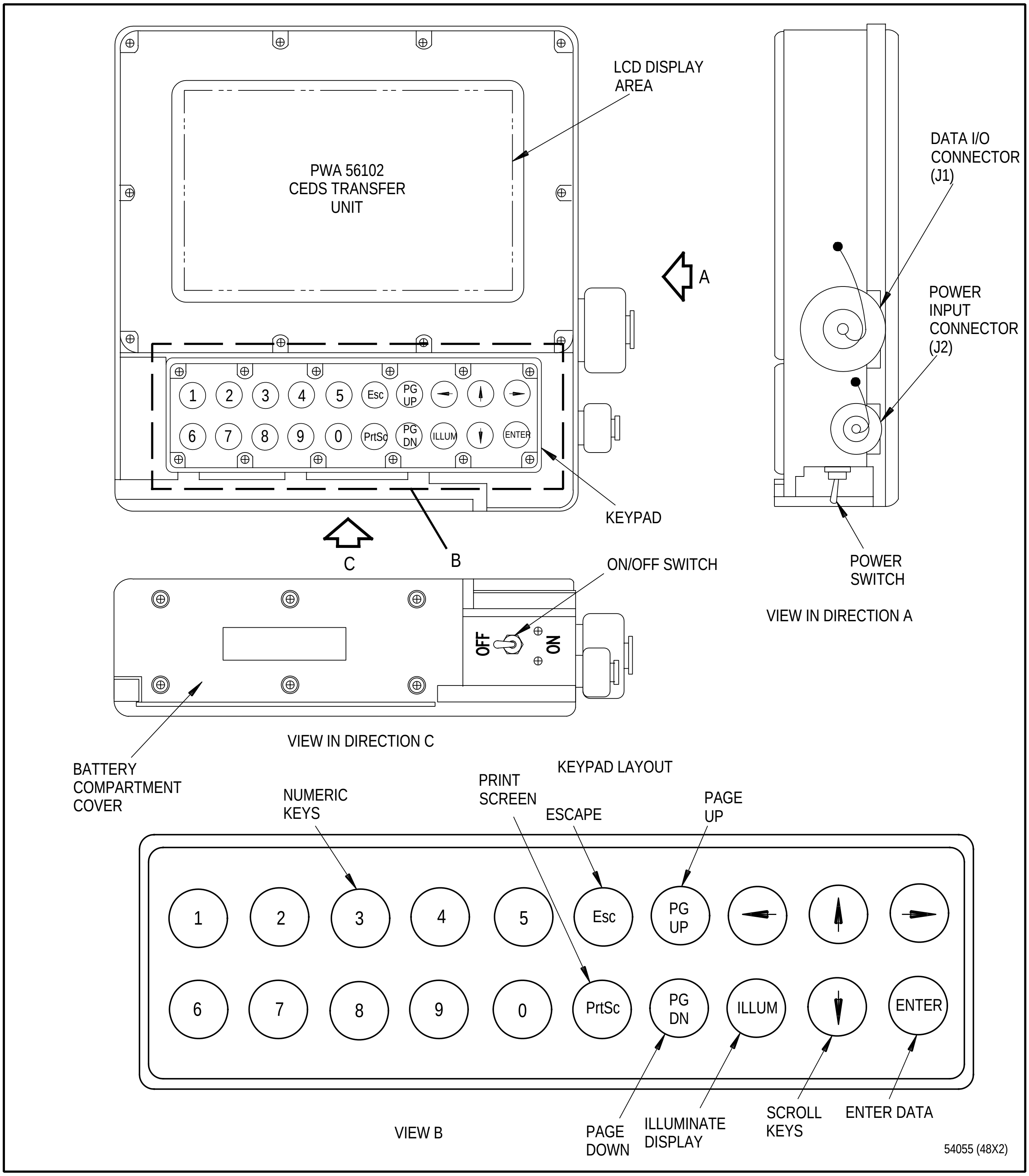


Figure 2. CEDS Transfer Unit

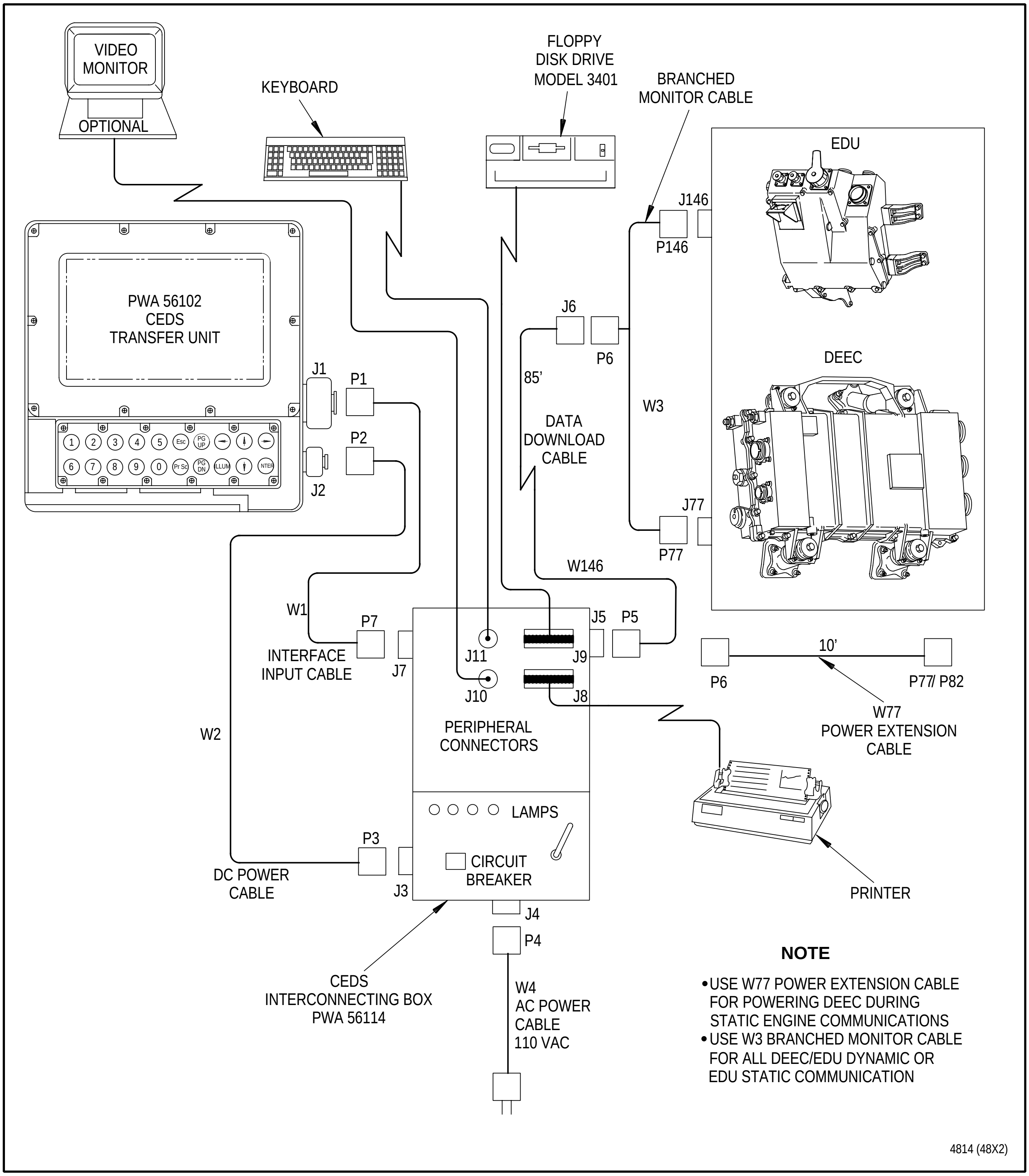


Figure 3. CEDS Communication Cable Connections

3. LOAD LOGIC UPDATE.
(See figures 1 through 4).

NOTE

- EDU/DEEC software revisions are performed when authorized by a Time Compliance Technical Order (TCTO). A floppy disk containing revised codes will accompany the TCTO. Software revisions are accomplished by uploading revision codes into EDU Electronically Erasable Programmable Read-Only Memory (EEPROM). The revision codes will be maintained in CEDS memory for a period of 15 days.
- Press escape (ESC) key at anytime to return to Main Menu.
- CEDS can be shut OFF at anytime provided CEDS Transfer Unit displays the Main Menu.
- Press (PrtSc) key to print any screen.

a. Starting with CEDS MAIN MENU, press (3, figure 4.) or select FLOPPY ARCHIVE then press ENTER.

b. Perform LOAD LOGIC UPDATE FILES as follows:

(1) Press (4) or select LOAD LOGIC UPDATE FILES and press ENTER.

(2) Insert EDU/DEEC logic update files into external floppy disk drive.

(3) Press ENTER to transfer logic update files into CEDS computer. Wait for data transfer to be completed. Press any key to continue.

(4) Press ESC key to return to Main Menu.

4. EDU LOGIC UPDATE.
(See figures 1 through 4.)

NOTE

- Press escape (ESC) key at anytime to return to Main Menu.
- CEDS can be shut OFF at any time provided CEDS Transfer Unit displays the Main Menu.
- Press (PrtSc) key to print any screen.
- EDU software revisions are preformed when authorized by a Time Compliance Technical Order (TCTO). A floppy disk containing revised codes will accompany the TCTO. Software revisions are accomplished by uploading revision codes into EDU Electronically Erasable Programmable Read-Only Memory (EEPROM). The revision codes will be maintained in CEDS memory for a period of 15 days. CEDS will automatically erase the codes at end of specified time.
- First, ensure LOAD LOGIC UPDATE function has been performed from FLOPPY ARCHIVE menu.

a. Starting with CEDS MAIN MENU, press (0, figure 4.) or select EDU COMMUNICATIONS then press ENTER.

b. Perform EDU LOGIC UPDATE as follows:

(1) Press (3) or select EDU LOGIC UPDATE and press ENTER.

NOTE

Update cannot be completed if EDU update files do not exist.

(2) Ensure proper cable connections (see figures 2 and 3), press any key to UPDATE EDU LOGIC. Screen will show EDU logic update successfully completed.

(3) Press any key to acknowledge software revision.

(4) Press ESC key to return to Main Menu.

5. DEEC LOGIC UPDATE.

(See figures 1 through 4.)

NOTE

- Press escape (ESC) key at anytime to return to Main Menu.
- CEDS can be shut OFF at any time provided CEDS Transfer Unit displays the Main Menu.
- Press (PrtSc) key to print any screen.
- DEEC software revisions are preformed when authorized by a Time Compliance Technical Order (TCTO). A floppy disk containing revised codes will accompany the TCTO. Software revisions are accomplished by uploading revision codes into DEEC Electronically Erasable Programmable Read-Only Memory (EEPROM). The revision codes will be maintained in CEDS memory for a period of 15 days. CEDS will automatically erase the codes at end of 15 days.

a. Starting with CEDS MAIN MENU, press (1, figure 4.) or select DEEC COMMUNICATIONS then press ENTER.

b. Perform DEEC LOGIC UPDATE as follows:

(1) Press (2) or select DEEC LOGIC UPDATE and press ENTER.

NOTE

Update cannot be completed if DEEC update files do not exist.

(2) Ensure cables W146 DATA and W77 POWER are in series between tester and engine J77 (see figures 2 and 3.). Press any key to UPDATE DEEC LOGIC. Screen will show DEEC logic was successfully completed.

(3) Press any key to acknowledge software revision.

(4) Press ESC key to return to Main Menu.

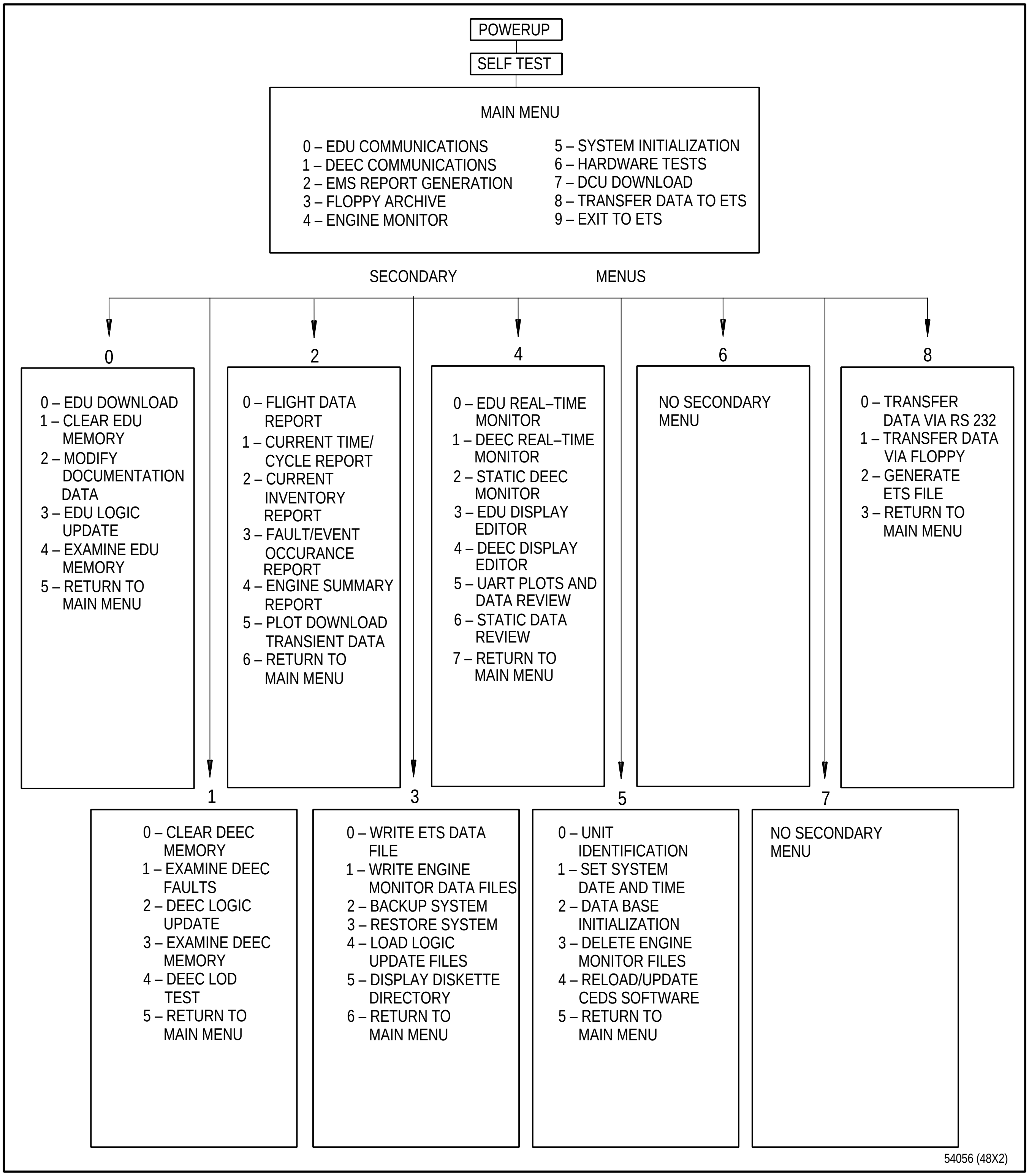


Figure 4. CEDS Operational Flow Chart

6. ERROR MESSAGES.

(See figures 1 through 4.)

NOTE

For the following six Communication Diagnostic ERROR messages, the first line gives an indication of the operation being performed and the second line will give Error number. Although the messages are worded differently, the corrective actions are all the same.

MESSAGE	CORRECTIVE ACTION
Communication Diagnostic ERROR messages are numbered as follows: 1-Timeout on block transfer 2-Block transmission error 3-No. ACK received from EDU/DEEC 4-No handshake with EDU/DEEC 5-Data written/received mismatch 6-SYNC words not found	• Record error message. • Perform Check on Transfer Unit battery/power supply and DSIA cables. Refer to T.O. 33D4-6-745-2. • Retry COMMUNICATIONS. • Perform Transfer Unit HARDWARE TESTS. Refer to T.O. 31S5-4-2142-2. • Replace Transfer Unit if test fails. • Replace DEEC/EDU.
Begin handshake with DCU Sending request for size command Sending request for data command Receiving DCU blocks... Transmission failed - errors detected! Press any key to continue...	• Check cable connections (W7 and W101). • Check DCU battery. • Try again (recycle DCU). • Perform Loop back check (EBIT). Refer to T.O. 31S5-4-2142-2. Replace Transfer Unit if test fails.
Drive not ready (0) Abort, (1) Retry?	• Check floppy drive cable connections. • Check floppy drive to ensure diskette is properly inserted. • Retry. • Replace floppy disk drive.
No EDU update files exist! Press any key to continue...	• Update file has been deleted (more than 15 days). Reload files. • Retry disk or try new disk.
Unable to identify correct fault codes.	• Invalid data is presnt in EDU fault counter registers. • Perform EXAMINE DEEC FAULTS.

MESSAGE	CORRECTIVE ACTION
Performing file integrity checks... Update file integrity checks failed, process aborted! Press any key to continue...	• Reload logic update file.
Performing file integrity checks... EDU EEPROM ID more recent than attempted update, process aborted! Press any key to continue...	• Operator has tried to load an older revision than what the Transfer Unit has stored in memory. Check revision status and reload correct version.
Receiving UART, waiting for valid program identification	• Wait for proper engine N2 RPM (2000) and try again. • Possibility of a bad memory in EDU/DEEC. Start engine, shut down and restart engine. Replace EDU/DEEC if required.
WARNING: Duplicate engine data, download not stored in data base! ENGSN : 740000 ACTN : 00-0000 EDUSM : BEDU0009 EDU ID : 5-020102 EDU EEPROM : 005 (Typical Data)	• This prevents CEMS IV from getting overloaded with previously stored data.
Error occurred determining the PROGRAM ID Calculated PROGRAM ID does not represent a valid map Press any key to continue...	• Device definition beyond the scope of CEDS. If no communications are possible, contact SA-ALC/LDAD for assistance.
LOW VOLTAGE FAILURE - CEDS system halted! Internal power monitoring indicates insufficient voltage for system functions. Turn off unit and recharge batteries...	• Recharge batteries or replace with charged batteries.

7. POST-OPERATION PROCEDURES.

(See figures 1 through 4).

CAUTION

- To prevent possible damage to CEDS and peripherals, do not disconnect cables during data uploading.
- To prevent possible damage to Transfer Unit, turn ICM computer POWER switch OFF before disconnecting Transfer Unit from power source.

a. Press ESC key to return to MAIN MENU.

b. Turn ICM computer POWER switch OFF.

WORK PACKAGE

TECHNICAL PROCEDURES

TESTING LIGHT-OFF DETECTOR USING CEDS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 8	12	9 - 11 Added	12	12 Blank	0

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Troubleshooting	T.O. 2J-F100-11-3
System Fault Code 4160: LOD Unit	WP 618 00
CEDS Transfer Unit	T.O. 31S5-4-2142-2
Diagnostic System Interface Assembly	T.O. 33D4-6-745-2
Comprehensive Engine Diagnostic System (CEDS)	T.O. 33D4-6-746-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

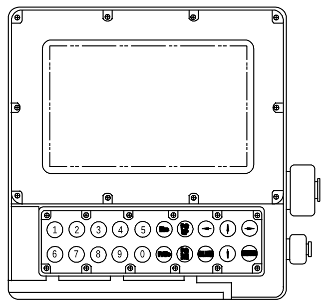
EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

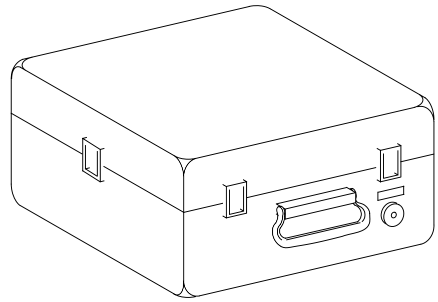
Paragraph	Function - Tool Nomenclature	Tool Number
	CEDS Software	PWA 56091
	Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114
	Floppy Disk Drive	Model/3401 or Equivalent
2	CEDS Set-Up	
3	DEEC LOD Test	
4	Error Messages	
5	Post-Operation Procedures	

ILLUSTRATED SUPPORT EQUIPMENT



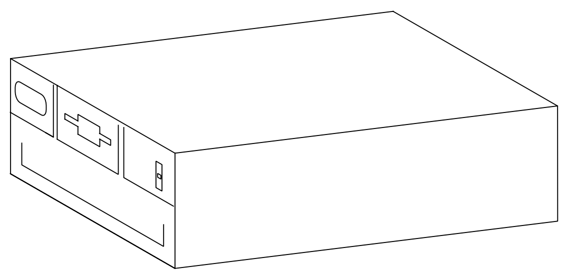
PWA 56102 –C

Figure T1. PWA 56102 Transfer Unit



PWA 56114 –C

Figure T2. PWA 56114 CEDS Interface Assembly



54347

Figure T3. Model/3401 Floppy Disk Drive

1. INTRODUCTION.

a. This work package contains procedures to test engine-mounted Light-Off Detector (LOD) using Comprehensive Engine Diagnostic System (CEDS) (PWA 56091 software, PWA 56102 transfer unit, and PWA 56114 Diagnostic System Interface Assembly - DSIA).

b. These procedures functionally test LOD to isolate LOD faults and augmentor malfunctions. LOD, Digital Electronic Engine Control (DEEC), and CEDS shall be connected to do this test.

c. The DEEC functionally tests LOD automatically during engine start and augmentor operation. This procedure allows CEDS to instruct DEEC to start test, and DEEC communicates with LOD to do test. After test, DEEC sends test results to CEDS.

NOTE

Troubleshooting procedures for Light-Off Detector are located in WP 618 00.

d. The LOD has an internal ultraviolet (UV) light source. During LOD functional test, UV light source is detected by an ultraviolet sensing tube in the LOD. Signal from DEEC turns UV light source on and off to test LOD’s capability to detect light and no-light conditions. The LOD returns a signal to DEEC indicating presence or absence of UV light (flame) in the duct.

e. Deleted.

f. Deleted.

2. CEDS SET-UP.
(See Figures 1, 2, 3, and 4.)

a. Figure 1 shows communication between elements of Engine Monitoring System (EMS).
Figure 2 shows CEDS Transfer Unit.
Figure 3 shows CEDS communication cable connections.
Prepare CEDS for use. Refer to T.O. 33D4-6-746-1 and T.O. 31S5-4-2142-2.

CAUTION

To prevent erroneous operation, ensure CEDS computer, DEEC, and LOD are connected through proper and secure cables before attempting CEDS/DEEC/LOD communications.

b. Turn Interconnection Module (ICM) computer POWER switch ON.

3. DEEC LOD TEST.
(See Figures 1 through 4.)

NOTE

- Press escape (ESC) key at any time to return to Main Menu.
- CEDS can be shut OFF at any time provided CEDS Transfer Unit displays Main Menu.
- Press (PrtSc) key to print any screen.

a. Starting with CEDS MAIN MENU, press (1, figure 4.) or select DEEC COMMUNICATIONS and press ENTER.

b. Perform DEEC LOD TEST as follows:

(1) Press (4) or select DEEC LOD TEST and press ENTER.

(2) Ensure cables W146 DATA and W77 POWER are in series between tester and engine J77 (See figure 3.). Press any key to perform DEEC LOD TEST.

(3) Press ENTER to acknowledge test results.

CAUTION

To prevent damage to CEDS and DEEC do not start engine with W77 power extension cable installed.

c. Press ESC key to return to Main Menu.

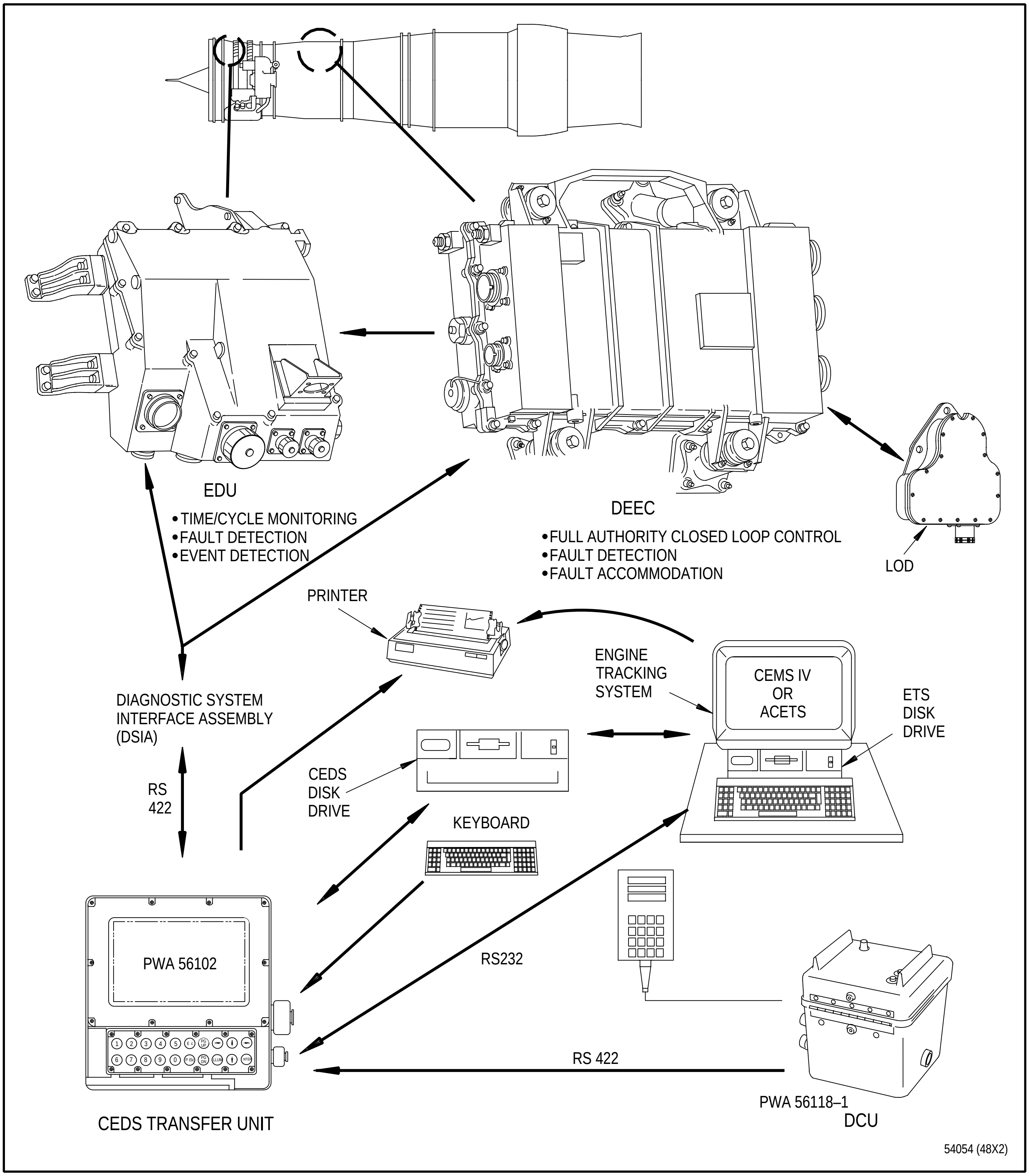


Figure 1. Engine Monitoring System

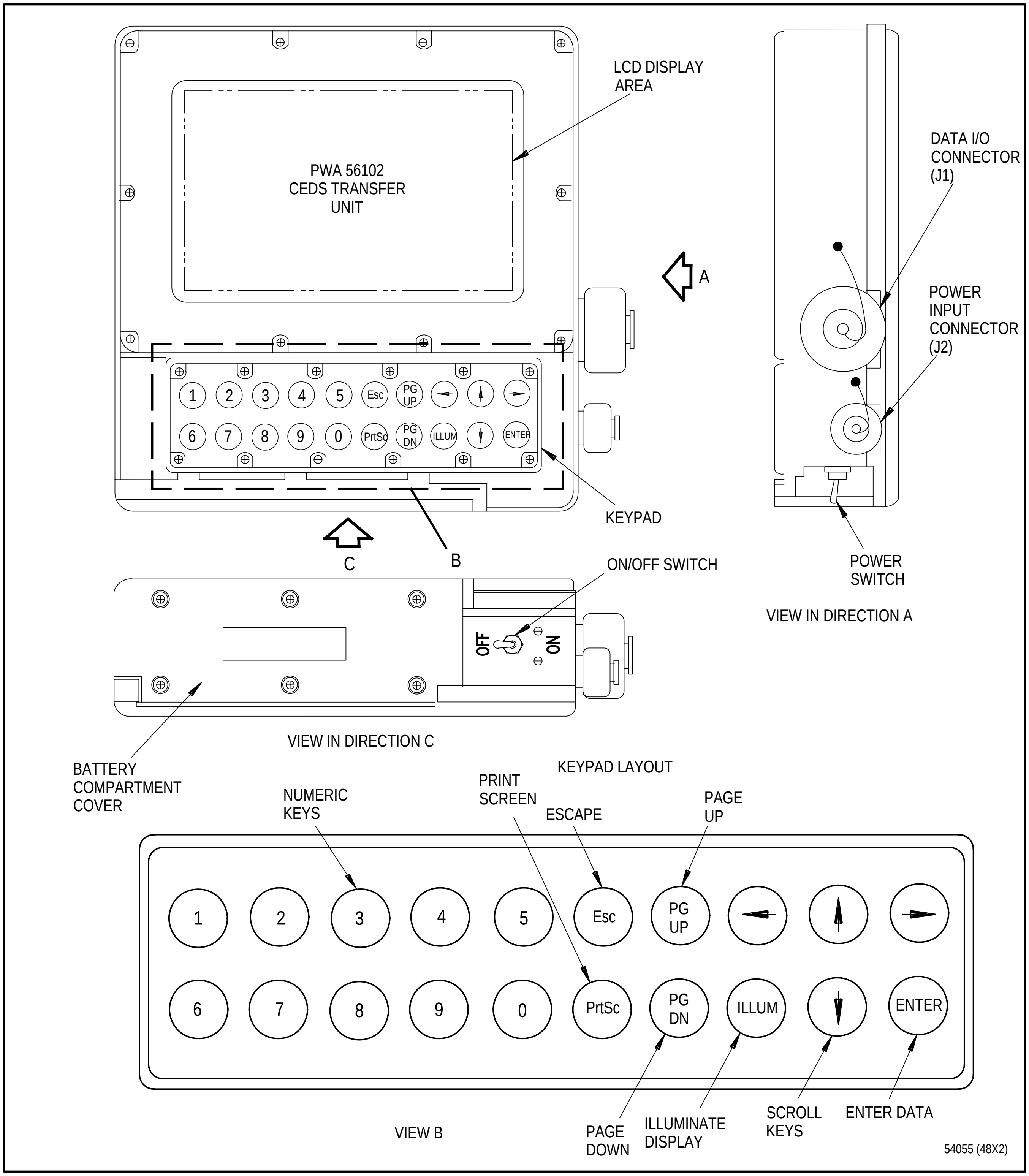


Figure 2. CEDS Transfer Unit

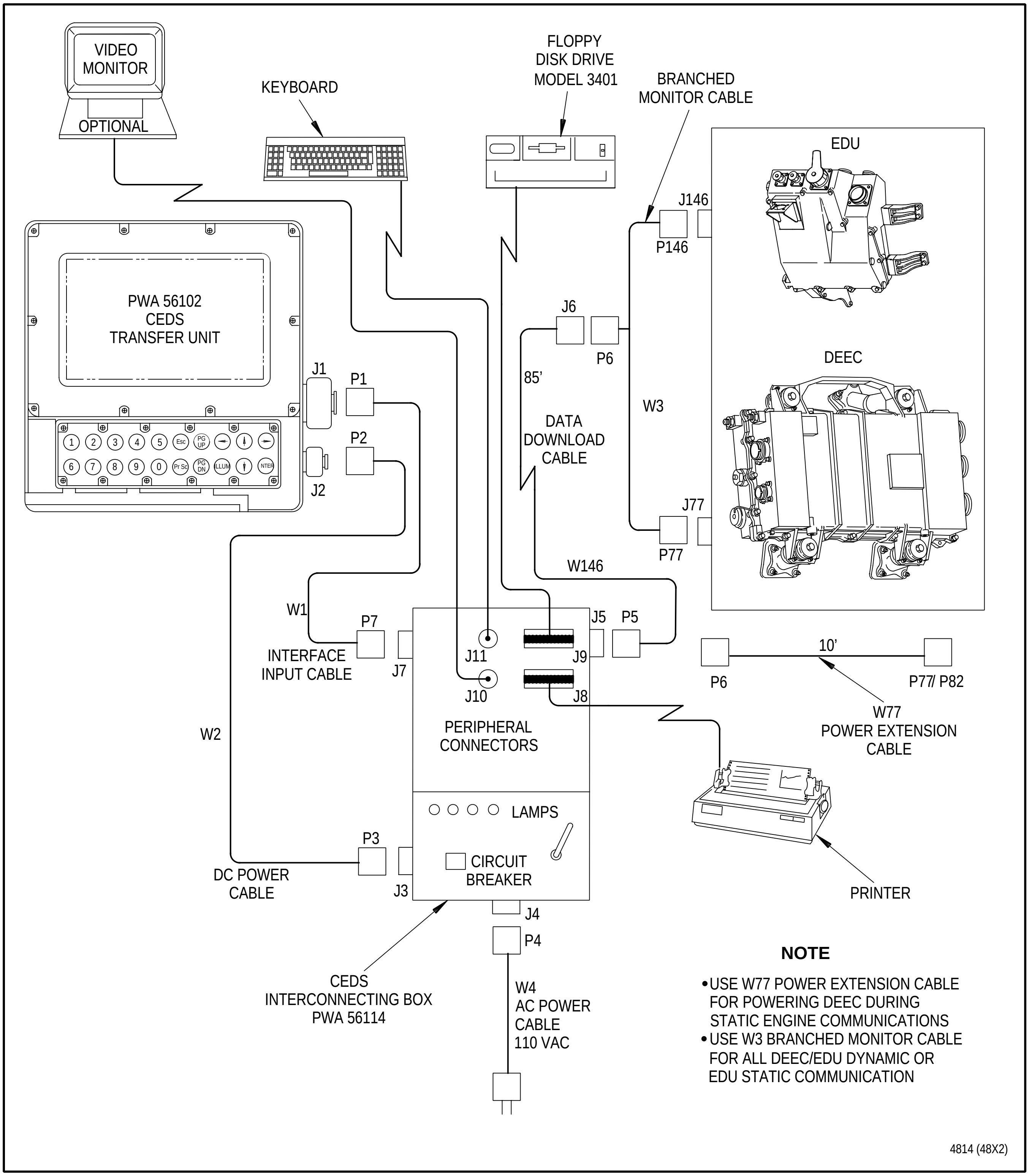


Figure 3. CEDS Communication Cable Connections

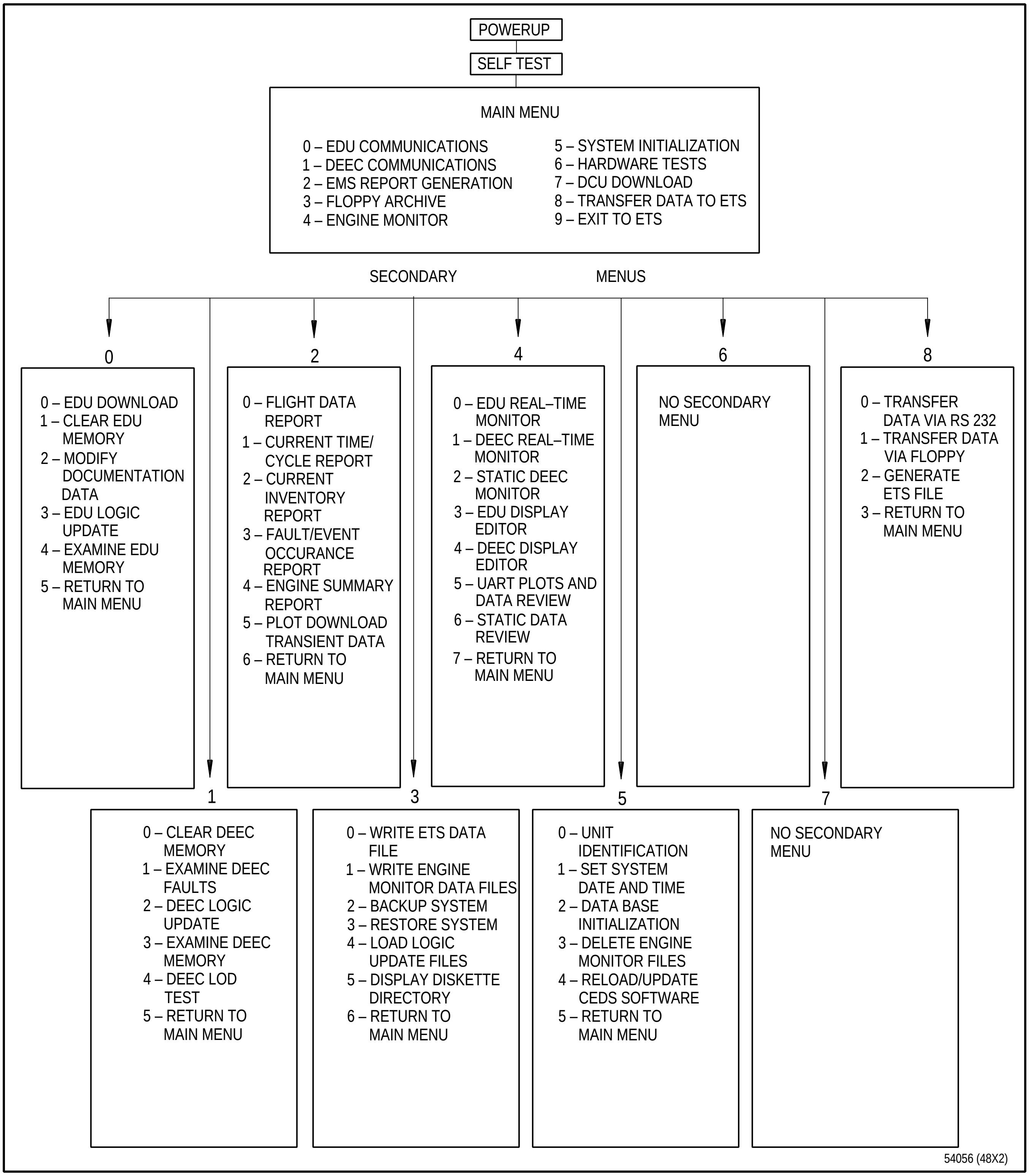


Figure 4. CEDS Operational Flow Chart

4. ERROR MESSAGES.
(See figures 1 through 4.)

NOTE

For the following six Communication Diagnostic ERROR messages, the first line gives an indication of the operation being performed and the second line will give Error number. Although the messages are worded differently, the corrective actions are all the same.

MESSAGE	CORRECTIVE ACTION
Communication Diagnostic ERROR messages are numbered as follows: 1-Timeout on block transfer 2-Block transmission error 3-No.ACK received from EDU/DEEC 4-No handshake with EDU/DEEC 5-Data written/received mismatch 6-SYNC words not found	• Record error message. • Perform Check on Transfer Unit battery/power supply and DSIA cables. Refer to T.O. 33D4-6-745-2 • Retry COMMUNICATIONS. • Perform Transfer Unit HARDWARE TESTS. Refer to T.O. 31S5-4-2142-2. Replace Transfer Unit if test fails. • Replace DEEC/EDU.
Begin handshake with DCU Sending request for size command Sending request for data command Receiving DCU blocks... Transmission failed - errors detected! Press any key to continue...	• Check cable connections (W7 and W101). • Check DCU battery. • Try again (recycle DCU). • Perform Loop back check (EBIT). Refer to T.O. 31S5-4-2142-2. Replace Transfer Unit if test fails.
Drive not ready (0) Abort, (1) Retry?	• Check floppy drive cable connections. • Check floppy drive to ensure diskette is properly inserted. • Retry. • Replace floppy disk drive
No EDU update files exist! Press any key to continue	• Update file has been deleted (more than 15 days). Reload files. • Retry disk or try new disk.
Performing file integrity checks... Update file integrity checks failed, process aborted! Press any key to continue	• Reload logic update file.
Unable to identify correct fault codes	• Invalid data is present in EDU fault counter registers. • Perform EXAMINE DEEC FAULTS.

MESSAGE	CORRECTIVE ACTION
Performing file integrity checks... EDU EEPROM ID more recent than attempted update, process aborted! Press any key to continue...	• Operator has tried to load an older revision than what the Transfer Unit has stored in memory. Check revision status and reload correct version.
Receiving UART, waiting for valid program identification	• Wait for proper engine N2 RPM (2000) and try again. • Possibility of a bad memory in EDU/DEEC. Start engine, shut down and restart engine. Replace DEEC/EDU if required.
WARNING: Duplicate engine data, download not stored in data base! ENGSN : 740000 ACTN : 00-0000 EDUSM : BEDU0009 EDU ID : 5-020102 EDU EEPROM : 005 (Typical Data)	• This prevents CEMS IV from getting overloaded with previously stored data.
Error occurred determining the PROGRAM ID: Calculated PROGRAM ID does not represent a valid map Press any key to continue...	• Device definition beyond the scope of CEDS. If no communications are possible, contact SA-ALC LDAD for assistance.
LOW VOLTAGE FAILURE - CEDS system halted! Internal power monitoring indicates insufficient voltage for system functions. Turn off unit and recharge batteries...	• Recharge batteries or replace with charged batteries.

5. POST-OPERATION PROCEDURES.

(See figures 1 through 4.)

CAUTION

- To prevent possible damage to CEDS, DEEC, or LOD, do not disconnect DSIA cables and components during CEDS/DEEC/LOD communication.
- To prevent possible damage to transfer unit, turn ICM POWER switch OFF before disconnecting transfer unit from power source.

a. Press ESC key to return to MAIN MENU.

b. Turn ICM computer POWER switch OFF.

WORK PACKAGE

TECHNICAL PROCEDURES

DOWNLOADING DCU-STORED DATA TO CEDS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 10

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 9	0				
10 Blank	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Data Collection Unit - Operation Instructions (This unit is designated as a data analysis control inreferenced technical manual.)	T.O. 33D4-6-666-1
Comprehensive Engine Diagnostic System	T.O. 33D4-TBD

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

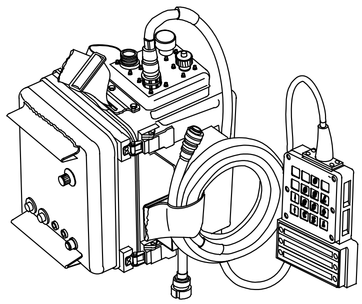
EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

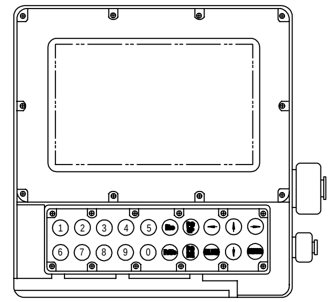
Paragraph	Function - Tool Nomenclature	Tool Number
2	CEDS Set-Up	
3	Downloading DCU-Stored Data	
4	Error Messages	
5	Post-Operation Procedures	
	Data Collection Unit	Typical
	CEDS Software	PWA 56091
	CEDS Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114

ILLUSTRATED SUPPORT EQUIPMENT



PWA 56015 –C

Figure T1. PWA 56015 Data Collection Unit (Typical)



PWA 56102 –C

Figure T2. PWA 56102 CEDS Transfer Unit

1. INTRODUCTION.

a. This work package contains procedures to download Data Collection Unit (DCU) data to the Comprehensive Engine Diagnostic System (CEDS) (PWA 56091 software, PWA 56102 transfer unit, and PWA 56114 Diagnostic System Interface - DSIA).

b. CEDS functions similarly to the DCU, and incorporates Ground Station Unit (GSU) functions that collect DCU-stored data. This downloading procedure allows DCU use where there is no GSU available.

c. DCU-stored data, downloaded to CEDS, is indistinguishable from data downloaded directly from the Engine Diagnostic Unit (EDU).

d. CEDS allows detailed EDU data review. Perform detail data review per T.O. 33D4-TBD. Refer to Table 1 of the manual for list of data available.

e. Refer to T.O. 33D4-6-686-1 for DCU operating procedures.

2. CEDS SET-UP.

(See Figures 1 and 2.)

a. Prepare CEDS for use per T.O. 33D4-TBD. Figure 1 details CEDS portable computer. Figure 2 details DCU/CEDS communication cable connections.

b. Prepare DCU for use per T.O. 33D4-6-686-1.

CAUTION

- To prevent possible damage to DCU and CEDS transfer unit, ensure DCU POWER button and computer power switch are OFF before connecting or disconnecting CEDS, electrical power or the power converter.
- To prevent possible damage to DCU or computer, PWA 56114 DSIA step-down transformer shall be used if power circuit is 220 VAC.
- To prevent erroneous downloading and possible damage to DCU and computer, do not use DSIA step-down transformer if power circuit is 110 to 125 VAC.
- To prevent erroneous downloading, ensure cable connections between DCU and computer are proper and secure.

c. Turn DCU POWER button ON. Turn CEDS transfer unit POWER switch ON.

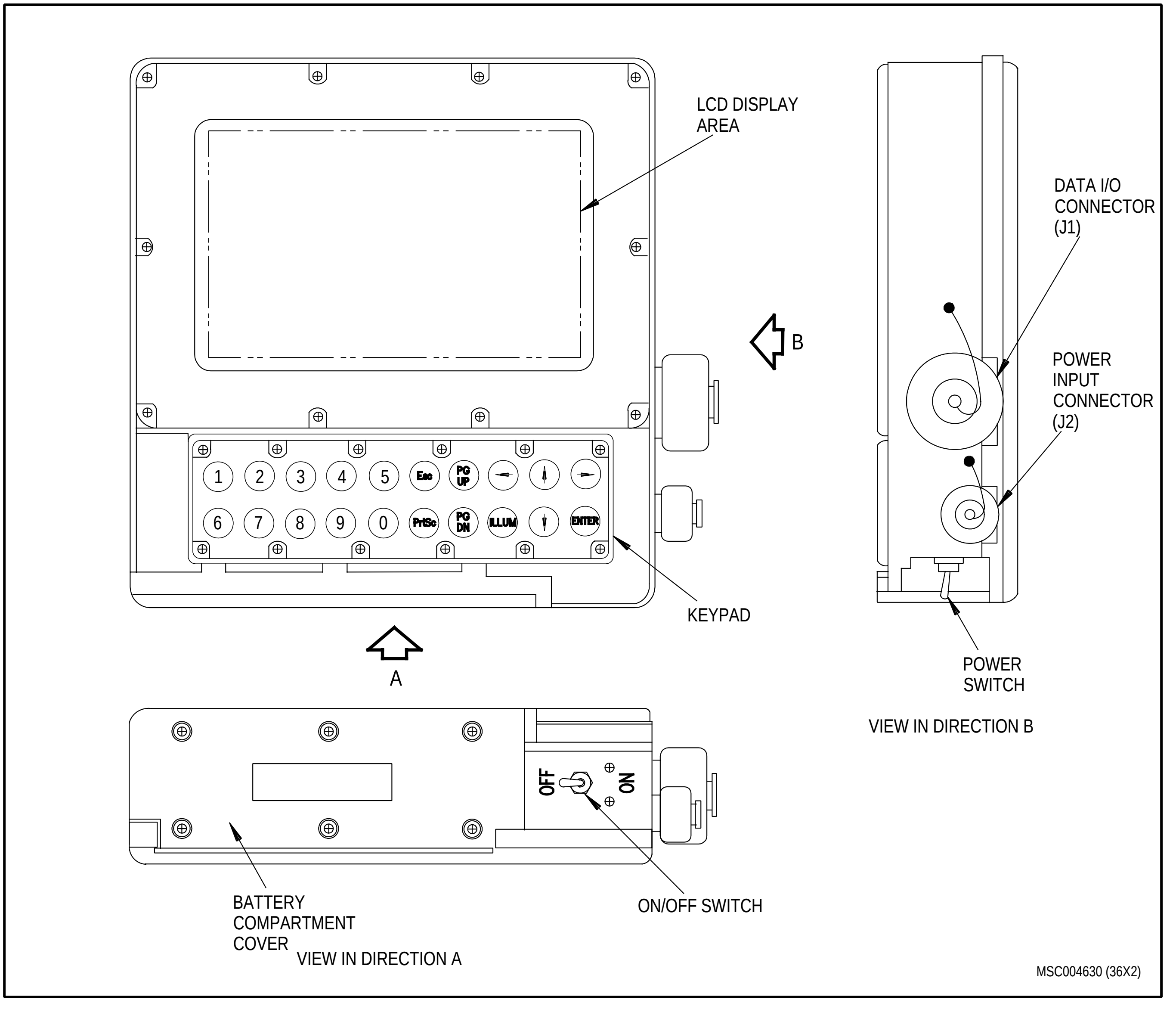


Figure 1. CEDS Portable Computer

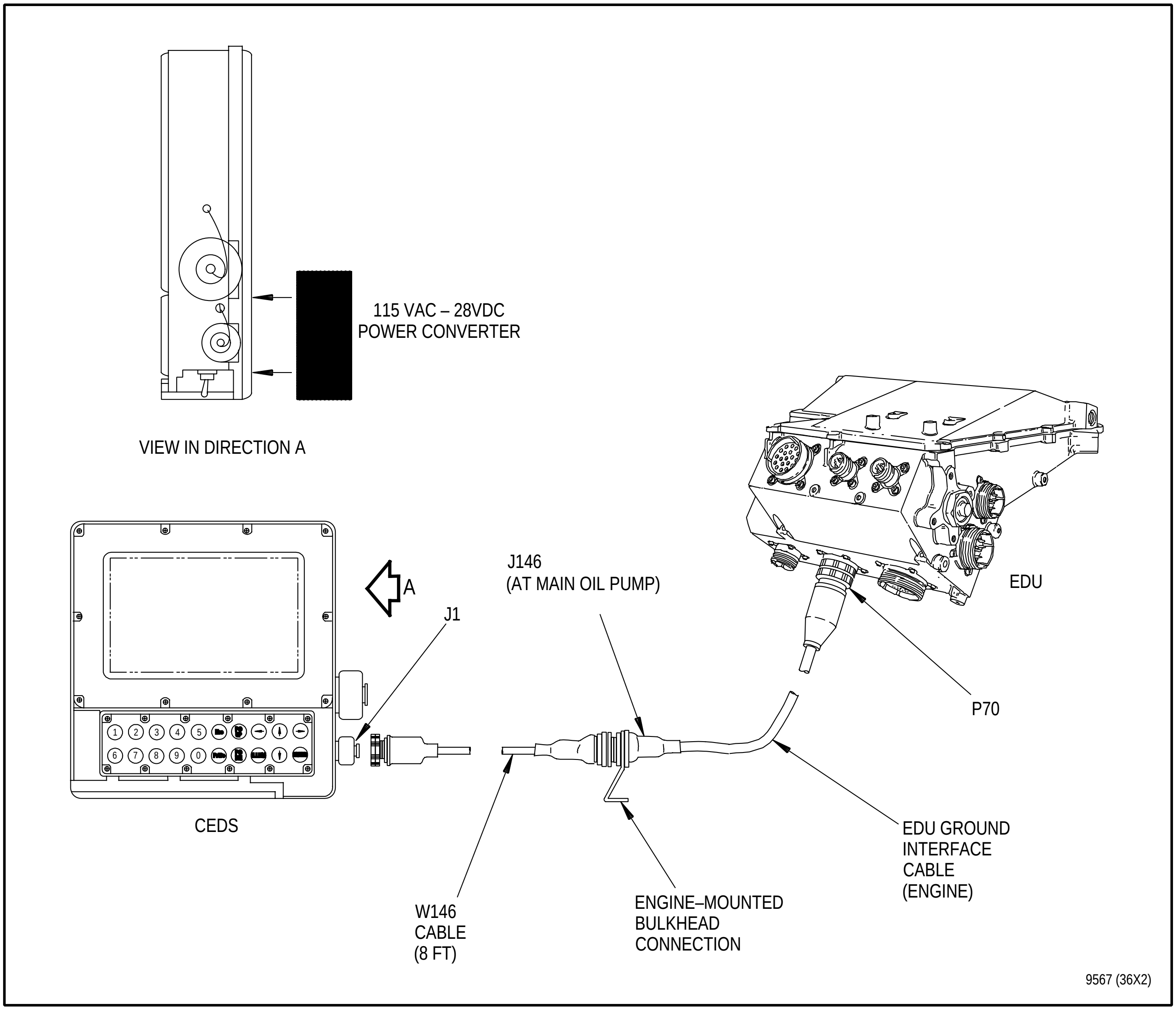


Figure 2. DCU/CEDS Communication Cable - Connections

3. DOWNLOADING DCU-STORED DATA.
(See figures 1 and 2, and Figure 3.)

a. Downloading DCU-stored data to CEDS is done in two steps: 1) DCU is prepared for communication and set to waiting mode. 2) CES starts communication and controls data flow.

b. Starting with DCU MAIN MENU perform the following selections and steps:
(See figures 1, 2, and 3.)

(1) Select MEM MOD DWNLO.

(2) Check cable connections. Press ENTER to continue.

(3) Press CONT to download memory module.

(4) Go to c.

c. Starting with CEDS MAIN MENU perform following selections and steps: (See figures 1, 2, and 3.)

(1) Select DCU DOWNLOAD.

(2) Check cable connections. Press ENTER to continue.

(3) Press ENTER to start download.

(4) Press ENTER to stop download summary report.

(5) Press ESC key to return to MAIN MENU.

(6) Press CONT or DCU to return to MAIN MENU.

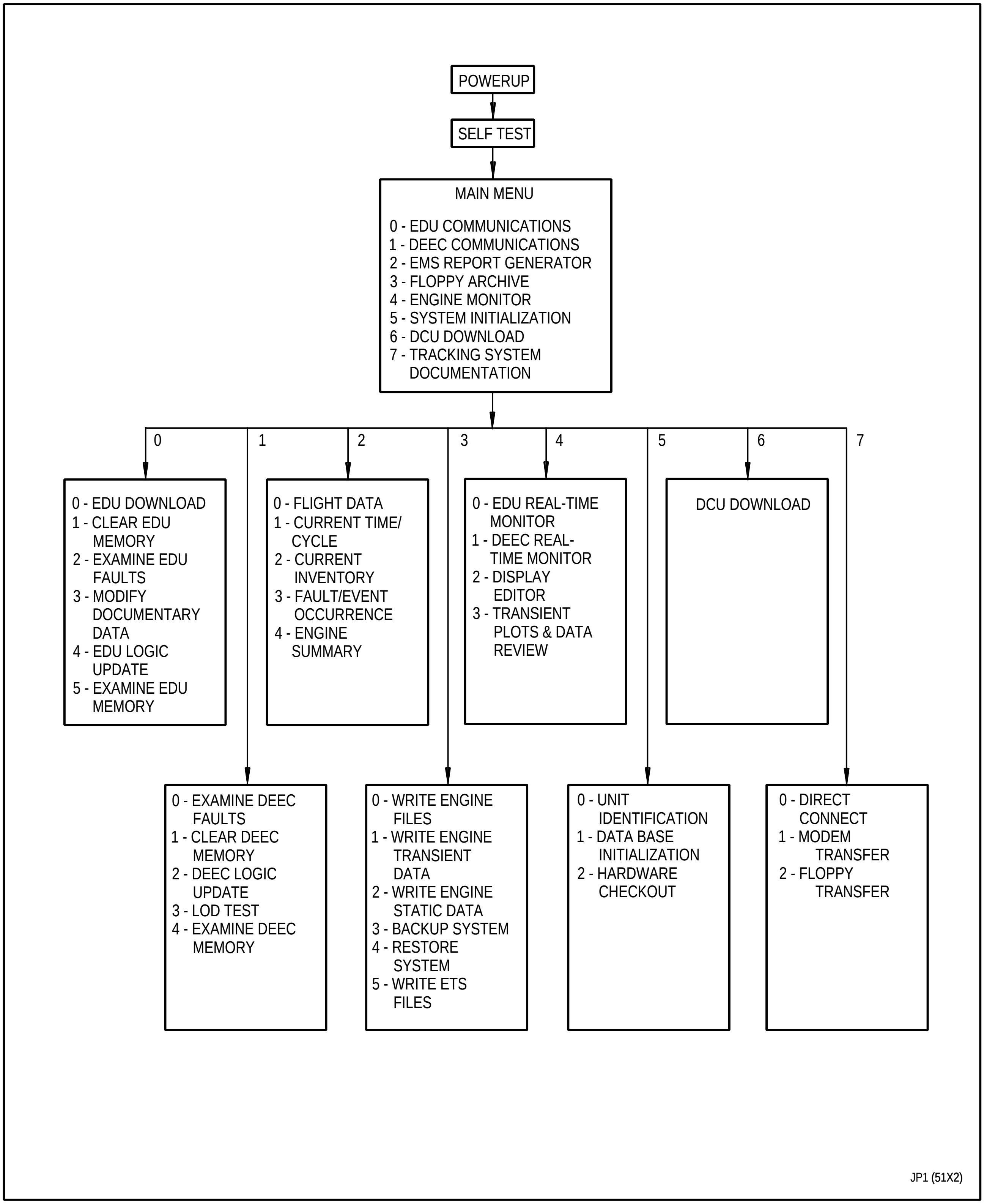


Figure 3. CEDS Operational Flow Chart

4. ERROR MESSAGES. (See figures 1 and 2.)

MESSAGE	CORRECTIVE ACTION
Error occurred downloading DCU: Error #X - XXXXXXXXXXXXXXXXXXXXXXXXX	• Record error message. • Ensure DCU is in MEM MOD DWNLD and attempting to send data. If not, select appropriate menu options and press CONT. • Check DEDS battery/power supply and DSIA cables. • Retry DCU DOWNLOAD. Replace CEDS HARDWARE CHECKOUT. Replace CEDS if test fails. • Replace DCU. • Remove memory module. • Replace DCU. • Reinstall memory module.

5. POST-OPERATION PROCEDURES. (See figures 1 and 2.)

CAUTION

- To prevent possible damage to DCU and CEDS, do not disconnect DSIA cables and components during DCU/CEDS communication.
- To prevent possible damage to DCU and CEDS, ensure DCU POWER button and CEDS computer POWER switch are OFF before disconnecting power source.

a. Turn DCU POWER button OFF.

b. Turn CEDS POWER switch OFF.

WORK PACKAGE

TECHNICAL PROCEDURES

MAIN FUEL PUMP FUEL PRESSURE ANALYSIS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 12	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Fuel System Contamination	WP 305 00
Engine Troubleshooting - General	WP 501 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
Compound, antigalling (PWA 550)	Hi-T-650 or Lubri-Bond HT
Lockwire (0.032 inch diameter)	MS9226-04

EXPENDABLE ITEMS

Nomenclature	Part Number	Quantity
Gasket	ST2229-04	2

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Main Fuel Pump Fuel Pressure Analysis	
	Pressure test set	PWA 56038

ILLUSTRATED SUPPORT EQUIPMENT

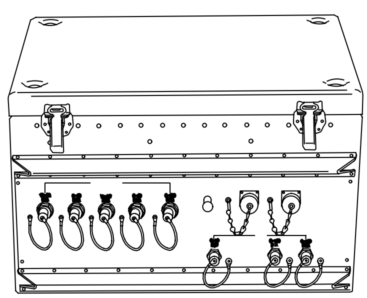


Figure T1. PWA 56038 Pressure Test Set

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for main fuel pump fuel pressure analysis.

2. MAIN FUEL PUMP FUEL PRESSURE ANALYSIS.

(See Figures 1 and 2, and Tables 1 through 3.)

a. Connect PWA 56038 pressure test set as follows (See figure 1.):

(1) Connect ground cable to GND lug on instrument case.

(2) Position test set POWER switch OFF.

(3) Connect BH 27394 interconnect cable to interconnect receptacle on instrument case and to interconnect receptacle on display unit.

(4) Connect BH 27395 power cable to power receptacle on instrument case and to 115V, 60 to 400 Hz power source.

b. Calibrate PWA 56038 pressure test set per table 1.

c. Install PDf1 and PDf2 pressure hoses as follows:

(1) Remove caps from diagnostic taps at PDf1 (main fuel pump) and PDf2 (main fuel pump). See figure 2.

CAUTION

To prevent damage to test set, connect hoses to test set ports only as specified in this procedure.

(2) Connect PN BH27676 hose to PDf1 tap and No. 10 pressure port on instrument case.

(3) Connect PN BH27676 hose to PDf2 tap and No. 11 pressure port on instrument case.

d. Purge PWA 56038 pressure test set and diagnostic hoses per table 2.

e. Perform engine test for MFP Pf1 and Pf2 pressures per table 3.

f. Turn POWER switch OFF.

g. Turn off fuel pump, tank valve, and regulator valve.

h. Remove power cable from power source and test set. Stow cable in accessory case.

i. Remove hoses from instrument case pressure ports and diagnostic taps. Drain fuel from hoses and stow.

j. Place protective caps on instrument case ports.

k. Install PN ST2229-04 gaskets on PDf1 and PDf2 taps. Install caps and torque 90 to 100 pound-inches. Lockwire using PN MS9226-04 wire.

Table 1. Pressure Test Set Calibration

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
1.	Place POWER switch ON.	XXXX THEN XXXX THEN XXXX THEN XXXX	a. Check that pressure test set is properly hooked up to external power source.
		D.U. XXXX HRS. THEN I.C. XXXX HRS. THEN * * *READY* * *	b. Repair or replace pressure test set.

Table 1. Pressure Test Set Calibration (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
2.	Remove all protective caps from pressure ports on instrument case.		
3.	Press O ADJ button	VENT ALL INPUTS	
4.	a. Press O ADJ button.	ALL VENTED	a. Repair or replace pressure test set.
	b. Press O ADJ button.	PUSHAGAINTOZERO	
	c. Press O ADJ button.	THEN O ADJ COMPLETE	

Table 2. Pressure Test Set Purging

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
1.	Connect purge line BH27677 to instrument box.		
2.	Put power lever in CUTOFF.		
3.	Turn test stand fuel pump switch ON.		
4.	Turn tank and regulator valves ON.		
5.	a. Select hose to be purged.	a. PURGE XXXX UNITS	
	b. Enter number to be purged.		
6.	Press and hold PURGE button and then press ENT buttons simultaneously. Purge until no air shows in fuel exiting purge line.	a. PURGE XXXX UNITS	
		b. Reduced pressure indication with purge in progress.	
		c. Fuel exits purge line.	Repair or replace pressure test set.
7.	Release PURGE and ENT buttons.		
8.	Repeat steps 5, 6, and 7 for each hose being purged.		

Table 3. Pf1 and Pf2 Pressure Test

CAUTION

- When performing the following test, do not exceed engine limits.
- If measuring lines and equipment are not set up properly, or if pressure lines are not bled properly, engine operation can be unstable.
- Very low Pf2 is a strong indication of main fuel pump failure. If pump failure is suspected, avoid further engine operation and check MFP filter for contamination.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
1.	Press SAVE button.	SAVE BLK (ENT)	
2.	Press + or - button to select data block 1.	SAVE BLK 1 (ENT)	
3.	Press ENT button. Type in engine serial number.	1 I.D. NO (ENT)	
4.	Motor engine at 2800 to 3400 N2 rpm.		
5.	Press ENT button.	1 XXXXXXX SAVED	
6.	Discontinue motoring.		
7.	Review data.	Pf2 - Pf1 is 275 to 475 psid.	Go to step 8.
8.	Press SAVE button.	SAVE BLK (ENT)	
9.	Press + or - button to select data block 2.	SAVE BLK (ENT)	

Table 3. Pf1 and Pf2 Pressure Test (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
10.	Press ENT button. Type in engine serial number.	(ENT)	
11.	Press right and left main ignition switches to deactivate right and left igniters.	Right and left ignition OFF light come on.	Troubleshoot test cell.
12.	Motor engine at 2800 to 3400 N2 rpm. Advance power lever to IDLE.		
13.	Press ENT button.	2 XXXXXXX SAVED	
14.	Move power lever to CUTOFF. Discontinue motoring. Check for fuel discharge from P&D valve.	Fuel dumps from P&D valve during engine spooldown.	Replace P&D valve.
15.	Review data in block 1 and block 2.	Pf2 - Pf1 is 275 to 475 psid.	a If Pf2 - Pf1 is below 275 psid in steps 15. and 7., replace MFP. b. If Pf2 - Pf1 is below 275 psid or above 475 psid in step 7. and is within limits in step 15., replace MFC. c. If Pf2 - Pf1 is above 475 psid in both steps 7. and 14., replace components in the following order until Pf2 - Pf1 is within limits: 1. MFC 2. P&D valve 3. Fuel nozzles

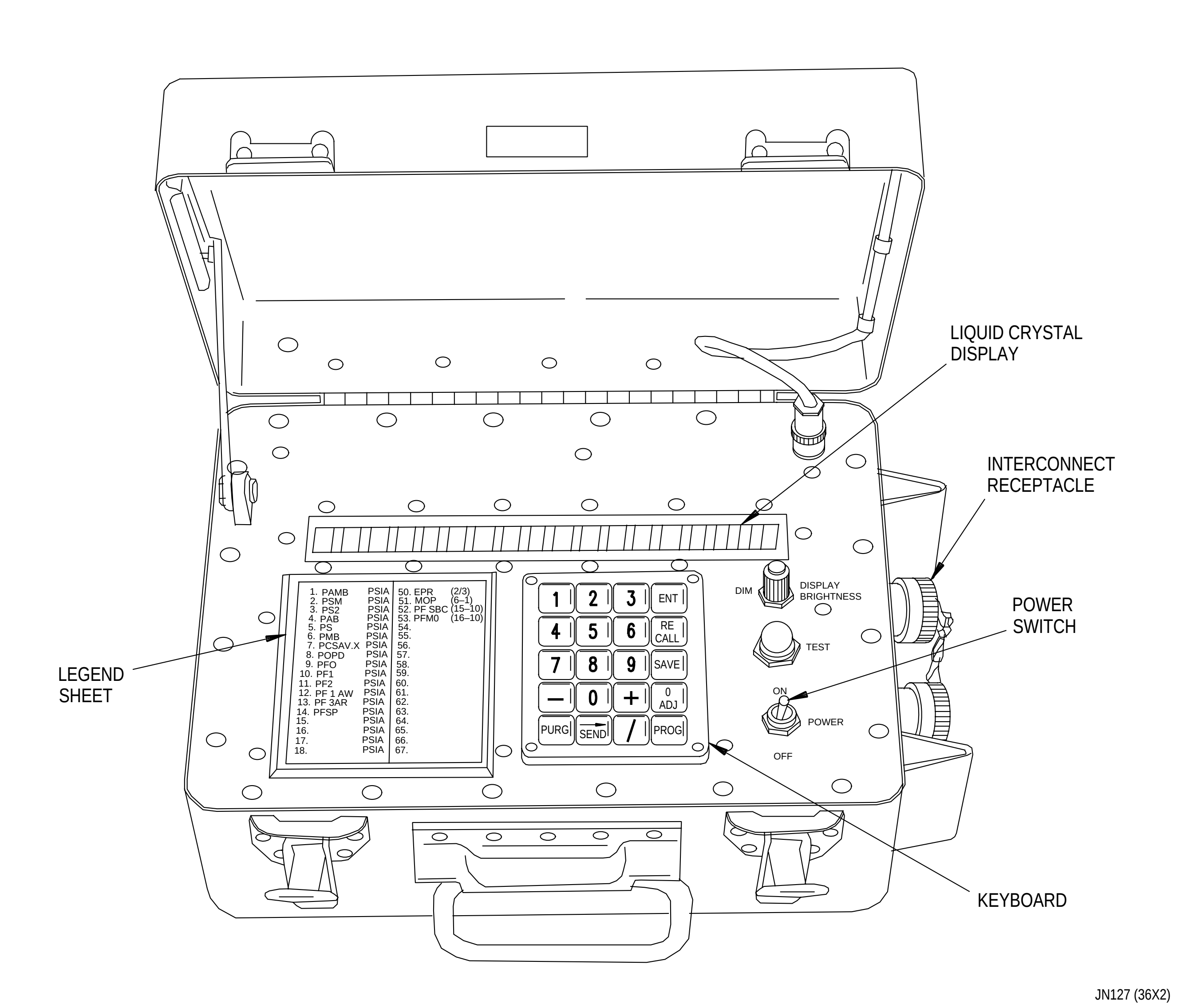


Figure 1. PWA 56038 Pressure Test Set (Sheet 1 of 3)

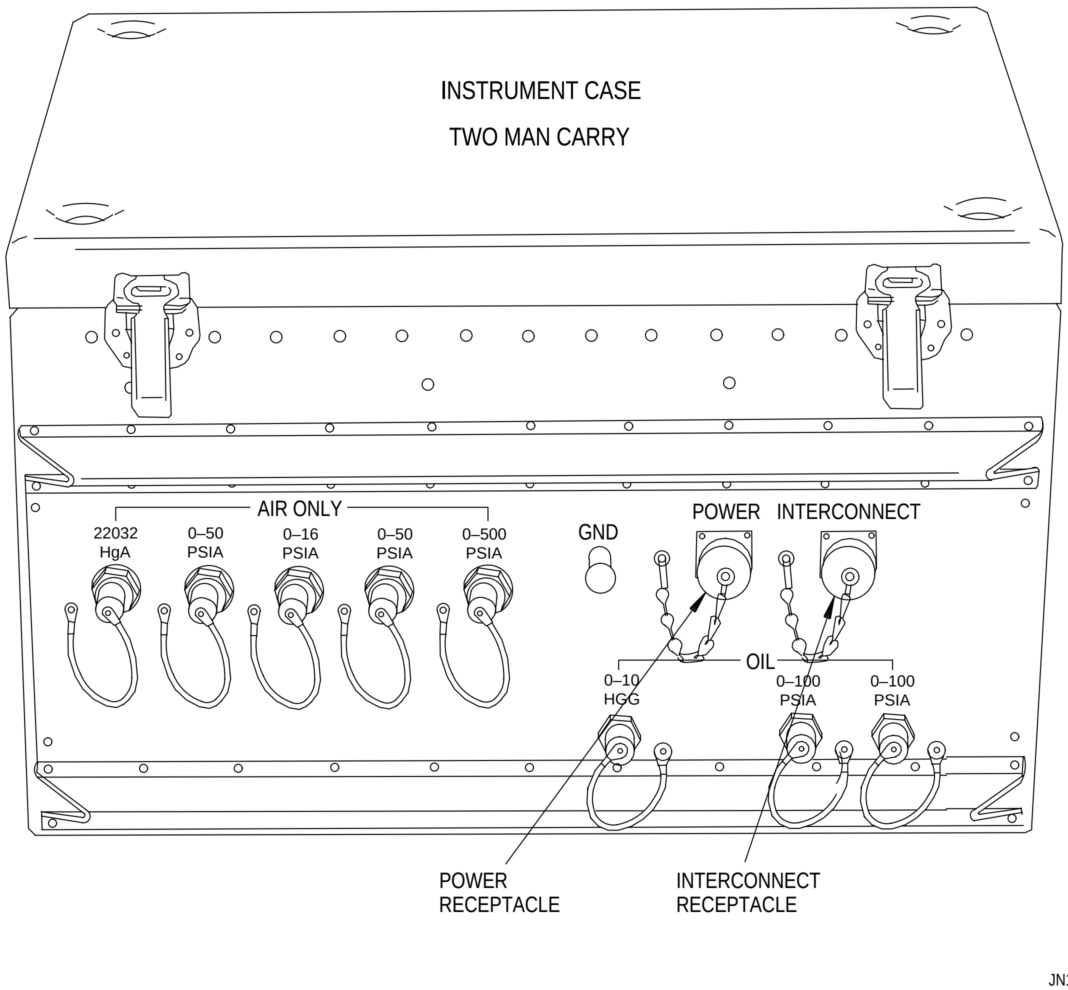


Figure 1. PWA 56038 Pressure Test Set (Sheet 2 of 3)

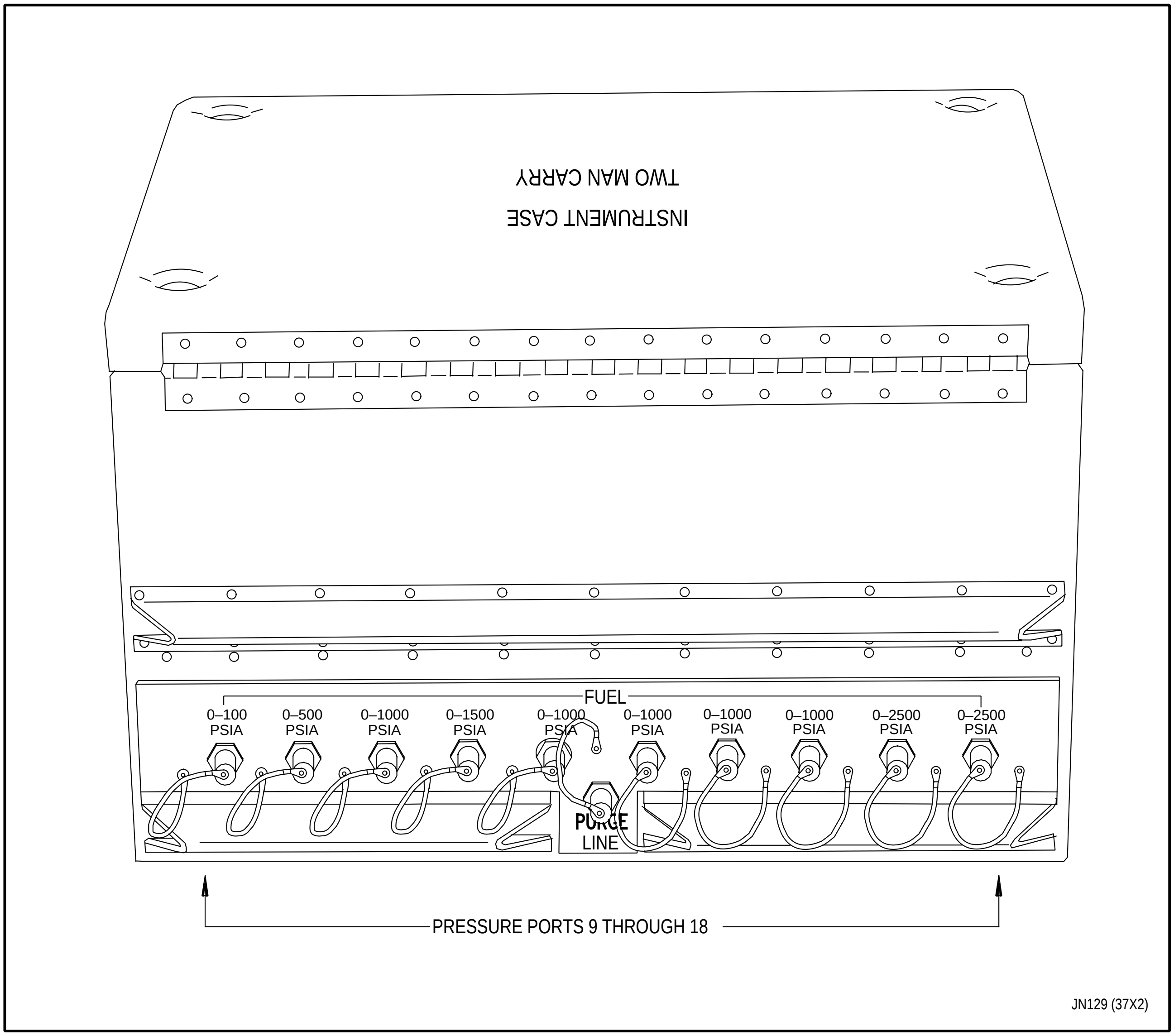


Figure 1. PWA 56038 Pressure Test Set (Sheet 3 of 3)

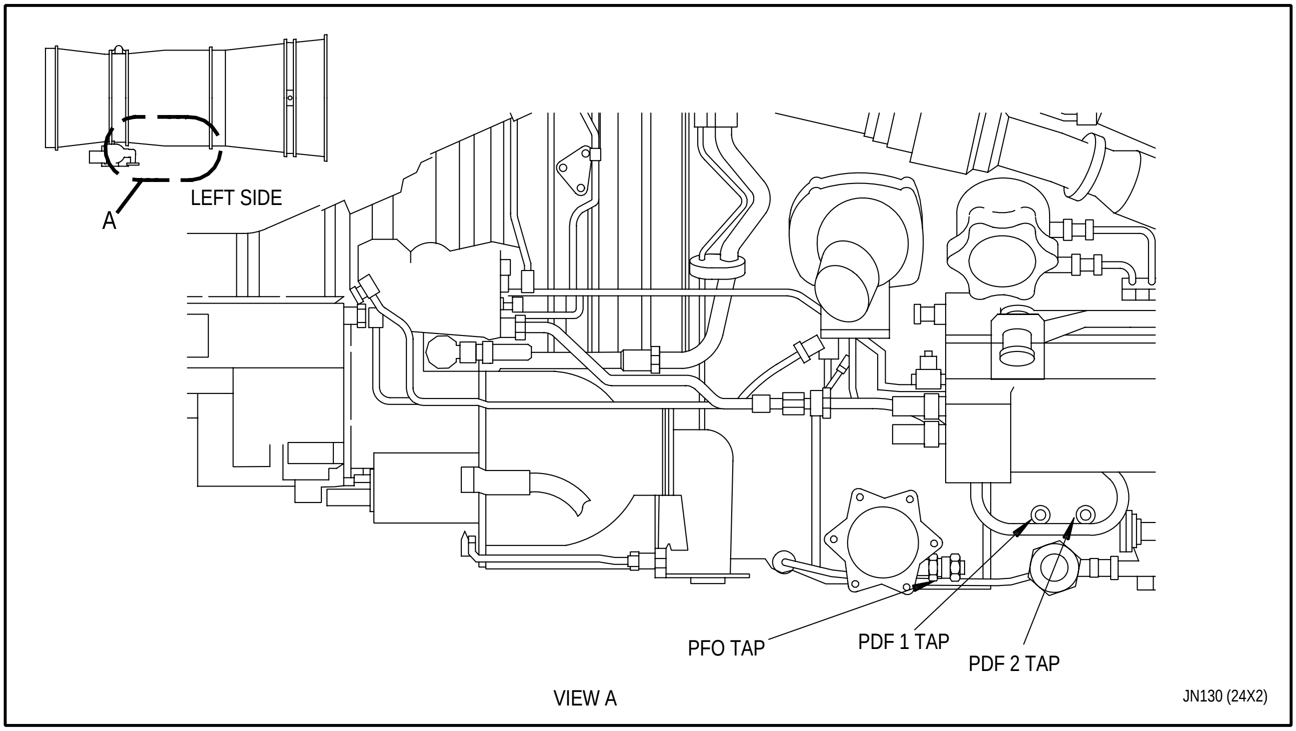


Figure 2. Main Fuel Pump - Diagnostic Taps

WORK PACKAGE

TECHNICAL PROCEDURES

AUGMENTOR FUEL SYSTEM ANALYSIS

EFFECTIVITY: ENGINE MODEL F100-PW-229

This Work Package Supersedes WP 662 00 Through and Including Basic Change.

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 20

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 19	6				
20 Blank	6				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Start Procedures	WP 210 00
Engine Shutdown Procedures	WP 225 00
Engine Fuel System Contamination	WP 305 00
Engine Troubleshooting - General	WP 501 00
Augmentor Anomalies	WP 512 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Engine Accessories and Rigging Procedures	WP 001 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

T.O. No.	Date	Level	Title (ECP No.)
T.O. 2J-F100229-517	15 Oct 92	O/I	Anti-Ice Valve Thermal Loop Isolation with New Manifold Assembly, Revised Electrical Harnesses, New Tubes and Brackets, F100-PW-229 Engines, F-15/F-16 Aircraft (ECP 92QA106 and ECP 90QA293C1)
T.O. 2J-F100229-518	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-15 Aircraft (ECP 92QA093)
T.O. 2J-F100229-519	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-16 Aircraft (ECP 92QA093)
T.O. 2J-F100229-524	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-15 Aircraft (ECP 92QA141)
T.O. 2J-F100229-525	30 Dec 92	O/I	Retrofit of New Nickel Base Alloy Tubes or Flexible Hose Assemblies for Various External Tubes, F100-PW-229 Engine, F-16 Aircraft (ECP 92QA141)

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
Lockwire (0.032 inch diameter)	MS9226-04

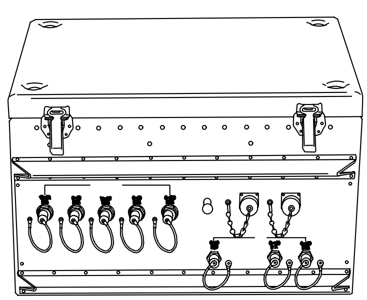
EXPENDABLE ITEMS

Nomenclature	Part Number	Quantity
Gasket	ST2229-04	3
Gasket	ST2229-05	1
Gasket	ST2229-06	1

APPLICABLE SUPPORT EQUIPMENT

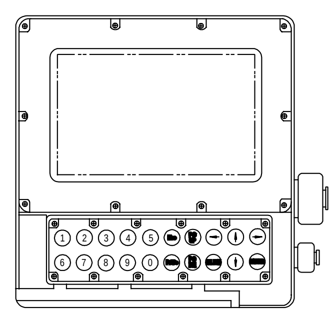
Paragraph	Function - Tool Nomenclature	Tool Number
2	Augmentor Fuel System Analysis	
	Pressure test set	PWA 56038
	CEDS Software	PWA 56091
	Transfer Unit	PWA 56102
	CEDS Interface Assembly	PWA 56114

ILLUSTRATED SUPPORT EQUIPMENT



PWA 56038 –C

Figure T1. PWA 56038 Pressure Test Set



PWA 56102 –C

Figure T2. PWA 56102 Transfer Unit

1. INTRODUCTION.

a. This work package contains a description and troubleshooting procedures for augmentor fuel system analysis.

(1) Hardware Description

(a) The pressure test set display unit is a portable unit which displays engine air, oil, and fuel pressures during troubleshooting.

(b) The pressure test set has the capability to store data for later recall and outputting to other equipment.

(2) System Operation

(a) Pressures are applied to ports on the instrument case which contain all the pressure transducers.

(b) The accessory case houses a display unit which displays any measured parameter that is selected on the unit’s keyboard.

2. AUGMENTOR FUEL SYSTEM ANALYSIS.

(See Figures 1 through 3, and Tables 1 through 4.)

a. Connect PWA 56038 pressure test set as follows (See figure 1.):

(1) Connect ground cable to GND lug on instrument case.

(2) Position test set POWER switch OFF.

(3) Connect BH 27394 interconnect cable to interconnect receptacle on instrument case and to interconnect receptacle on display unit.

(4) Connect BH 27395 power cable to power receptacle on instrument case and to 115V 60 to 400 Hz power source.

b. Calibrate PWA 56038 pressure test set per table 1.

Table 1. Pressure Test Set Calibration

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
1.	Place POWER switch ON.	XXXX THEN XXXX THEN XXXX THEN XXXX	a. Check that pressure test set is properly hooked up to external power source.
		D.U. XXXX HRS. THEN I.C. XXXX HRS. THEN * * *READY* * *	b. Repair or replace pressure test set.
2.	Remove all protective caps from pressure ports on instrument case.		
3.	Press O ADJ button.	VENT ALL INPUTS	

Table 1. Pressure Test Set Calibration (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
4.	a. Press O ADJ button. b. Press O ADJ button. c. Press O ADJ button.	ALL VENTED PushAgainToZero NOW DOING O ADJ THEN O ADJ COMPLETE	a. Repair or replace pressure test set.

c. Install Pfo, PDf1, Pf1aw, Pf3ar, and Pfap pressure hoses as follows:

(1) Remove caps from diagnostic taps at Pfo (on airframe plumbing) and PDf1 (main fuel pump). See figure 3.

(2) Remove caps from Pflaw, Pf3ar and Pfap diagnostic taps. See figure 2.

CAUTION

To prevent damage to test set, connect hoses to test set ports only as specified in this procedure.

(3) Connect BH27676 hose to Pfo tap and No. 9 pressure port (0 to 100 psia) on instrument case.

(4) Connect BH27676 hose to PDf1 tap and No. 10 pressure port (0 to 500 psia) on instrument case.

(5) Connect PN BH27676 hose to Pf1aw tap and No. 12 pressure port (0 to 1,500 psia) on instrument case.

(6) Connect PN BH27676 hose to Pf3ar tap and No. 13 pressure port (0 to 1,000 psia) on instrument case.

(7) Connect PN BH27676 hose to Pfap tap and No. 14 pressure port (0 to 1,000 psia) on instrument case.

(8) Turn test stand boost pumps ON.

d. Purge PWA 56038 pressure test set and diagnostic hoses per table 2.

Table 2. Pressure Test Set Purging

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
1.	Select hose for purging.		
2.	Press PURG and ENT buttons simultaneously. When purge is complete, release both buttons.	# PURGE XXX PSIA	Repair or replace pressure test set.
3.	Repeat steps 1 and 2 for each hose.		

e. Perform engine test for Pfo, PDf1, Pf1aw, Pf3ar, and Pfap pressures per table 3.

Table 3. Pfo, Pf1, Pf1aw, Pf3ar, and Pfap Pressure Test

CAUTION

- Engine operation can be unstable if measuring lines and equipment are not properly set up, or pressure lines are not properly bled.
- If Pf1aw exceeds 1,500 psia, the pressure test set pressure transducer must be calibrated, and pfap plumbing checked for correct tube assembly.

NOTE

The following component abbreviations are used in table 3:

• MFP - Main Fuel Pump • AFC - Augmentor Fuel Control • AFP - Augmentor Fuel Pump • AFPC - Augmentor Fuel Pump Controller.

Step	Procedure	Results	Corrective Action
1.	Press SAVE button.	SAVE BLK (ENT)	

Table 3. Pfo, PDf1, Pf1aw, Pf3ar, and Pfap Pressure Test (continued)

Step	Procedure	Results	Corrective Action
2.	Press + or – button to select DATA BLOCK 1.	SAVE BLK 1 (ENT)	
3.	Press ENT button. Enter engine serial number.	1 I.D.NO.(ENT)	
4.	Start engine per WP 210 00.		
5.	Slowly advance power lever to Intermediate (MIL) power. Stabilize 30 seconds.	a. Engine accelerates to Intermediate power with no faults.	a. Go to step 6.
		b. Engine does not accelerate to Intermediate power or system faults are present.	b. Troubleshoot.

NOTE

Fuel pressure readings fluctuating out of limits may result if test set vents fuel during engine operation.

Step	Procedure	Results	Corrective Action
6.	With engine at Intermediate (MIL) power, press ENT button.	1 XXXXXX SAVED	
7.	Record total fuel flow.		
8.	Press SAVE button.	SAVE BLK (ENT)	
9.	Press + or – button to select DATA BLOCK 2.	SAVE BLK 2 (ENT)	
10.	Press ENT button. Enter engine serial number.	2 I.D.NO.(ENT)	
11.	Slowly advance power lever to SEG 1 augmentation (PLAAB is 91 to 96 degrees or SVP on CEDS real-time read is 1.	a. Augmentor lights normally.	a. Go to step 12.
		b. Augmentor does not light or blows out.	b. Troubleshoot anomaly.

Table 3. Pfo, PDf1, Pf1aw, Pf3ar, and Pfap Pressure Test (continued)

Step	Procedure	Results5	Corrective Action
12.	With engine at SEG 1augmentation, press ENT button.	2 XXXXXX SAVED	
13.	Record CEDS WFAC parameter.		
14.	Press SAVE button.	SAVE BLK (ENT)	
15.	Press + or – button to select DATA BLOCK 3.	SAVE BLK 3 (ENT)	
16.	Press ENT button. Enter engine serial number.	3 I.D.NO.(ENT)	
17.	Slowly advance power lever to maximum augmentation(PLAAB is 127 to 130).	a. Maximum augmentor operation is normal.	a. Go to step 18.
		b. Maximum augmentor operation is unstable or blows out.	b. Troubleshoot anomaly.
18.	With engine at maximum augmentation, press ENT button.	3 XXXXXX SAVED	
19.	Record CEDS WFAB parameter.		
20.	Retard throttle to IDLE and perform engine shutdownper WP 225 00.		
21.	Review DATA BLOCK 1. Press RECALL, and + or – buttons to get to BLK 1. Press ENT button.		
a.	Check PDf1-Pfo at Intermediate (MIL) power. Enter 10 and press –, 9, RECALL, and ENT buttons.	a.1. PDf1-Pfo is 69 psid or greater.	a.1. Go to step b.

Table 3. Pfo, PDf1, Pf1aw, Pf3ar, and Pfap Pressure Test (continued)

Step	Procedure	Results	Corrective Action
21. (cont'd)		a.2. PDf1-Pfo less than 69 psid.	a.2. Replace MFP.
b.	Check Pflaw at Intermediate (MIL) power. Enter 12 and press RECALL, and ENT buttons.	b.1. Pf1aw less than 300 psia (indicates augmentor permission signal is OFF).	b.1. Go to step 22.
		b.2. Pf1aw is 300 psia or greater (indicates augmentor permission signal is ON).	b.2. Go to c (to isolate cause for augmentor permission ON at Intermediate (Mil)).
c.	Check Pfap at Intermediate (MIL) power. Enter 14 and press RECALL, and ENT buttons.	c.1. Pfap is 210 psia or greater (indicates AFC has given augmentor permission).	c.1. Replace AFC.
		c.2. Pfap less than 210 psia (indicates AFPC is cause for high Pf1aw at Intermediate (Mil)).	c.2. Replace AFPC.
22.	Review DATA BLOCK 2. Press RECALL and + or – buttons to get to BLK 2. Press ENT button.		
a.	Check PDf1-Pfo at minimum augmentation. Enter 10 and press –, 9, RECALL, and ENT buttons.	a.1. PDf1-Pfo is 69 psid or greater.	a.1. Go to step b.
		a.2. PfD1-Pfo is less than 69 psid.	a.2. Replace MFP.
b.	Check Pf1aw at SEG 1 augmentation. Enter 12 and press RECALL, and ENT buttons.	b.1. Pf1aw is 600 to 1,050 psia.	b.1. Go to step c.
		b.2. Pf1aw is greater than 1,050 psia or less than 600 psia.	b.2. Replace AFPC. If Pf1aw is still out of limits, replace AFC.
c.	Check Pfap at SEG 1 augmentation. Enter 14 and press RECALL, and ENT button.	c.1. Pfap is 300 to 470 psia.	c.1. Go to step d.
		c.2. Pfap is greater than 470 psia or less than 300 psia (abnormal).	c.2. Replace AFC.

Table 3. Pfo, PDf1, Pf1aw, Pf3ar, and Pfap Pressure Test (continued)

Step	Procedure	Results	Corrective Action
22. d.	Check Pf1aw-Pf3ar at SEG 1 augmentation. Enter 12 and press -, Enter 13, press RECALL and press ENT buttons.	d.1. Pf1aw-Pf3ar is 270 to 370 psid (normal).	d.1. Go to step 23.
		d.2. Pf1aw-Pf3ar is more than 370 or less than 270 psid (abnormal).	d.2. Replace AFPC. If Pf1aw-Pf3ar is still out of limits, replace AFC.
23.	Review DATA BLOCK 3. Press RECALL and + or – buttons to get to BLK 3. Press ENT button.		
a.	Check PDf1-Pfo at maximum augmentation. Enter 10 and press –, 9, RECALL, and ENT buttons.	a.1. PDf1-Pfo is 69 psid or greater.	a.1. Go to step b.
		a.2. PDf1-Pfo less than is 69 psid.	a.2. Replace MFP.
b.	Check Pf1aw at maximum augmentation. Enter 12, and press RECALL and ENT buttons.	b.1. Pf1aw is 600 to 1,050 psia.	b.1. Go to step c.
		b.2. Pf1aw greater than 1,050 or less than 600 psia.	b.2. Replace AFPC. If Pf1aw is still out of limits,replace AFC.
c.	Check Pfap at maximum augmentation. Enter 14 and press RECALL and ENT buttons.	c.1. Pfap is 300 to 470 psia (normal).	c.1. Go to step d.
		c.2. Pfap greater than 470 or less than 300 psia (abnormal).	c.2. Replace AFC.
d.	Check Pf1aw-Pf3ar at maximum augmentation. Enter 12 and press – button. Then, enter 13 and press RECALL and ENT buttons.	d.1. Pf1aw-Pf3ar is 270 to 370 psid.	d.1. Go to paragraph 2.f.
		d.2. Pf1aw-Pf3ar is more than 370 or less than 270 psid (abnormal).	d.2. Replace AFPC. If Pf1aw-Pf3ar is still out of limits,replace AFC.

f. Disconnect pressure hoses as follows:

(1) Turn POWER switch OFF.

(2) Remove hoses from Pfo, PDf1, Pflaw, Pf3ar, and Pfap diagnostic taps.

(3) Remove the other hose ends from Nos. 9, 10, 12, 13 and 14 pressure ports on instrument case. Drain fuel from hoses and stow.

(4) Place protective caps on instrument case ports.

NOTE

Conical gaskets may be installed to stop leaks.

(5) Install new PN ST2229-04 conical gasket, if required, on Pf1aw tap. Install cap and torque 65 to 75 pound-inches (90 to 100 pound-inches with conical gasket).

(6) Install new PN ST2229-05 conical gasket, if required, on Pf3ar tap. Install cap and torque 100 to 110 pound-inches (120 to 135 with conical gasket).

(7) Install new PN ST2229-06 conical gasket, if required, on Pfap tap. Install cap and torque 130 to 140 pound-inches (135 to 150 pound-inches with conical gasket).

(8) Install new PN ST2229-04 conical gasket, if required, on Pfo and PDf1 tap. Install cap and torque 65 to 75 pound-inches (90 to 100 pound-inches with conical gasket).

(9) Lockwire all caps.

(10) Disconnect power cable from test set and power source. Stow cable in accessory case.

g. Return to applicable augmentor Event or Fault work package.

Table 4. Fuel System Pressure Limits

CAUTION

Main fuel pump failure can cause fuel system contamination resulting in operational problems and hot section distress. Very low Pf2 or Pf2 equaling Pfo or PDf1 are strong indications of main fuel pump failure. If pump failure is suspected, avoid further engine operation and check MFP filter for contamination.

Fuel System Parameters					Operating Limits	
DESCRIPTION	SYMBOL	MOTORING (23 TO 27% N2 RPM)	IDLE	MIL	MIN (SEG 1)	MAX (SEG 11)
MFP INTERSTAGE ΔP	PDf1-Pfo (psid)	-	-	69 and above	69 and above	69 and above
AFP DISCHARGE	PF1aw (psia)	-	-	LT 300	600 to 1,050	600 to 1,050
AUG PUMP CONTROLLER ΔP	Pflaw - Pf3ar	-	-	-	270 to 370	270 to 370
AUG PERMISSION SIGNAL ΔP	Pfap (psia)	-	-	LT 210	300 to 470	300 to 470

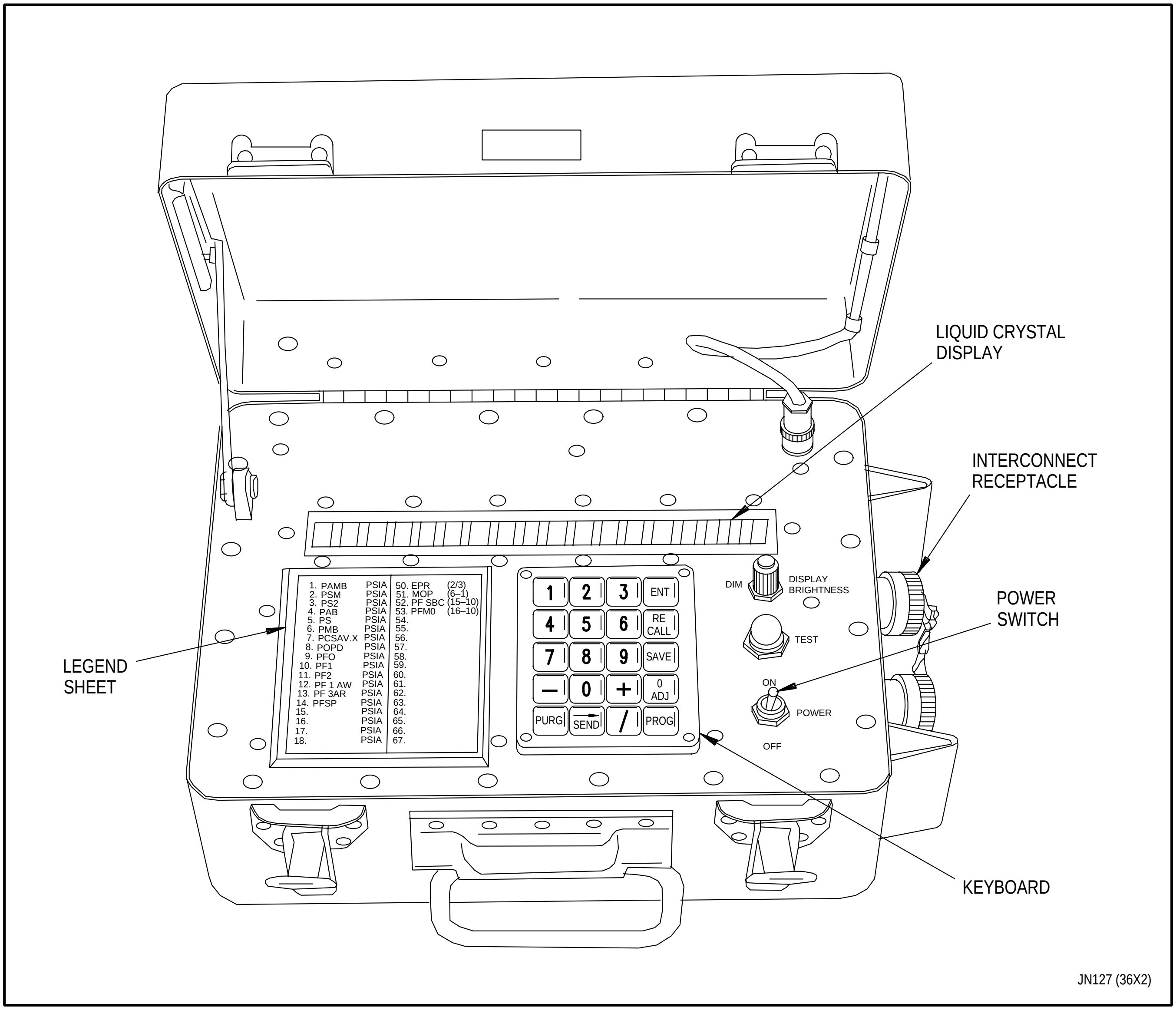


Figure 1. PWA 56038 Pressure Test Set (Sheet 1 of 3)

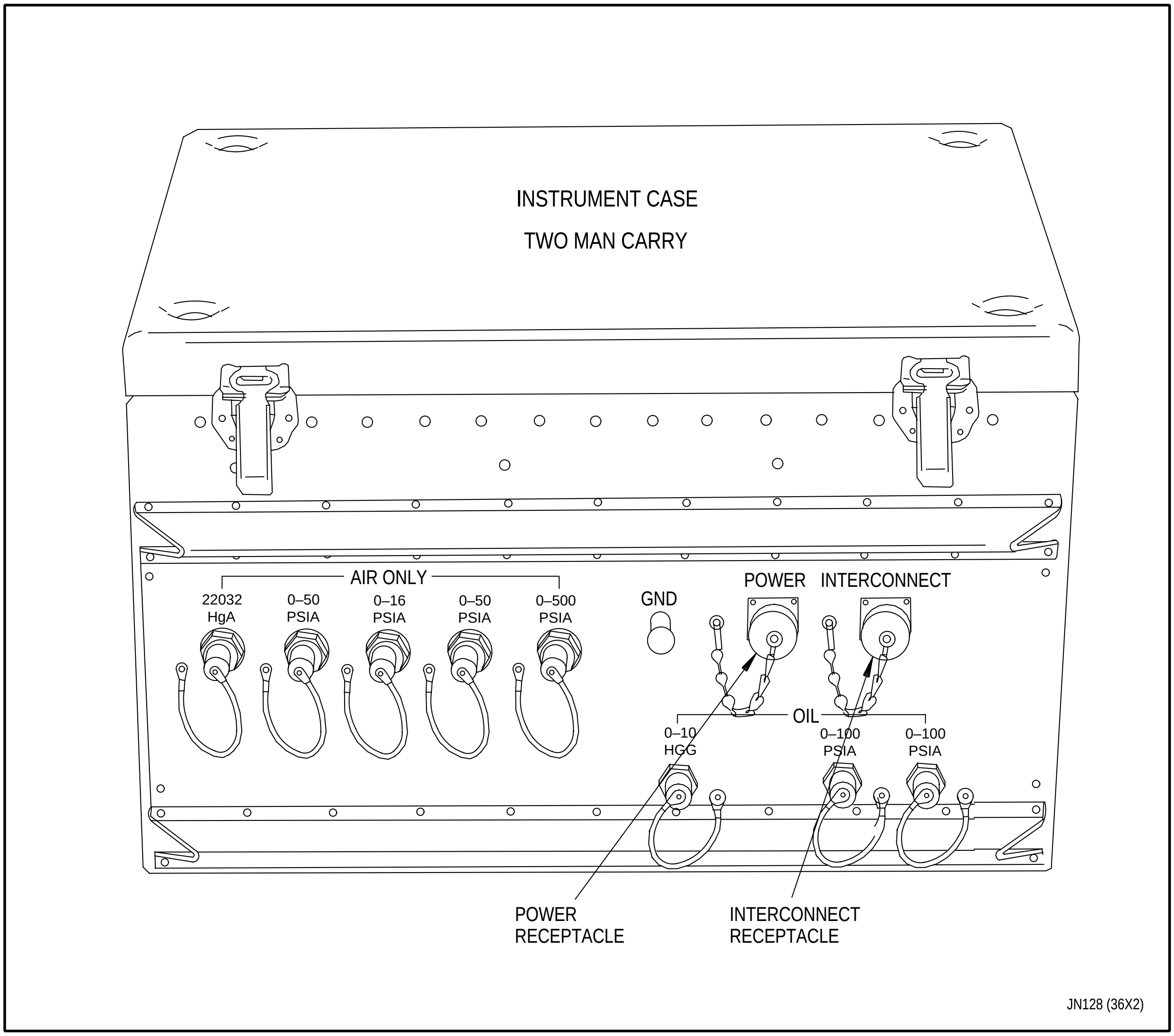


Figure 1. PWA 56038 Pressure Test Set (Sheet 2 of 3)

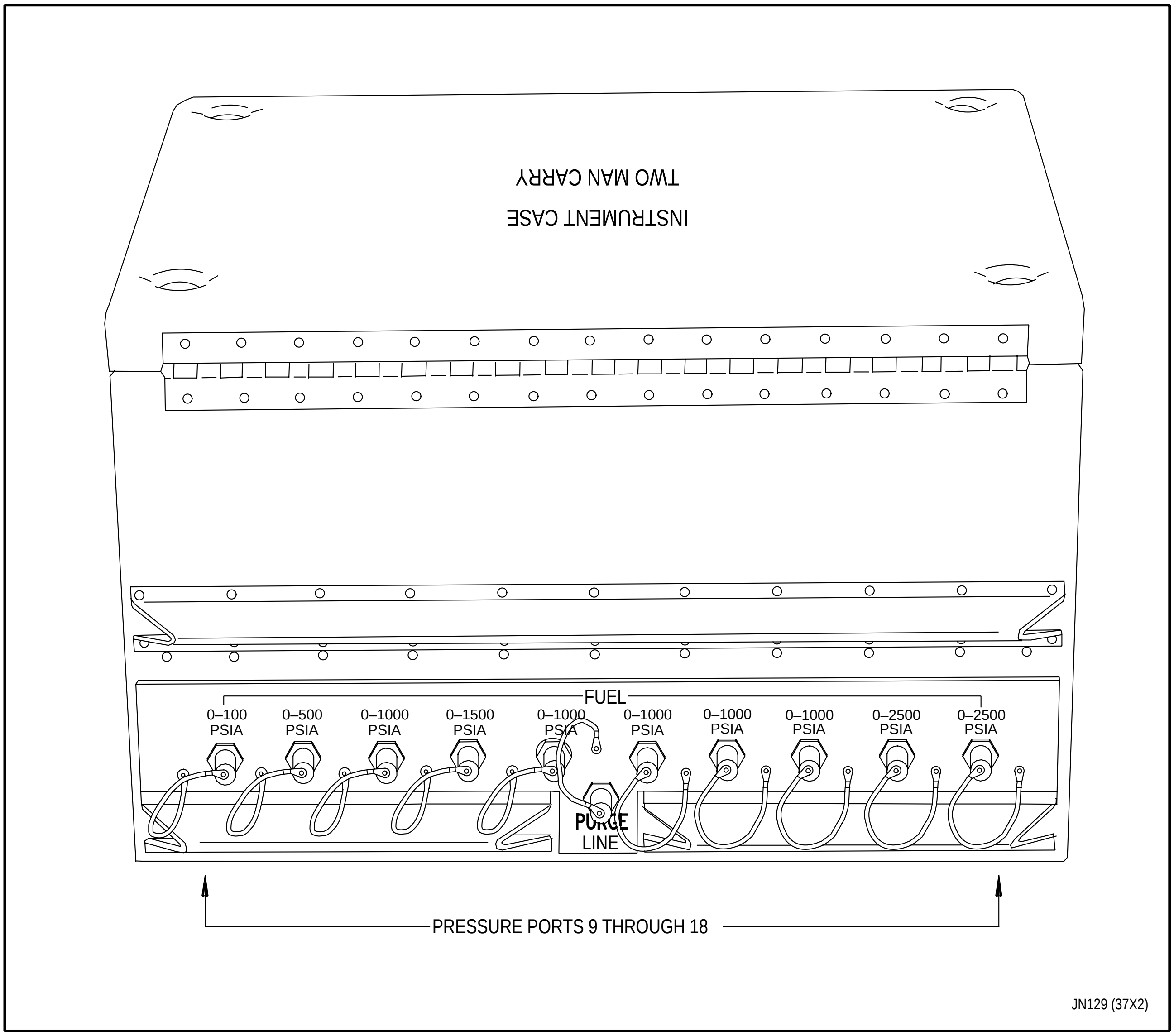


Figure 1. PWA 56038 Pressure Test Set (Sheet 3 of 3)

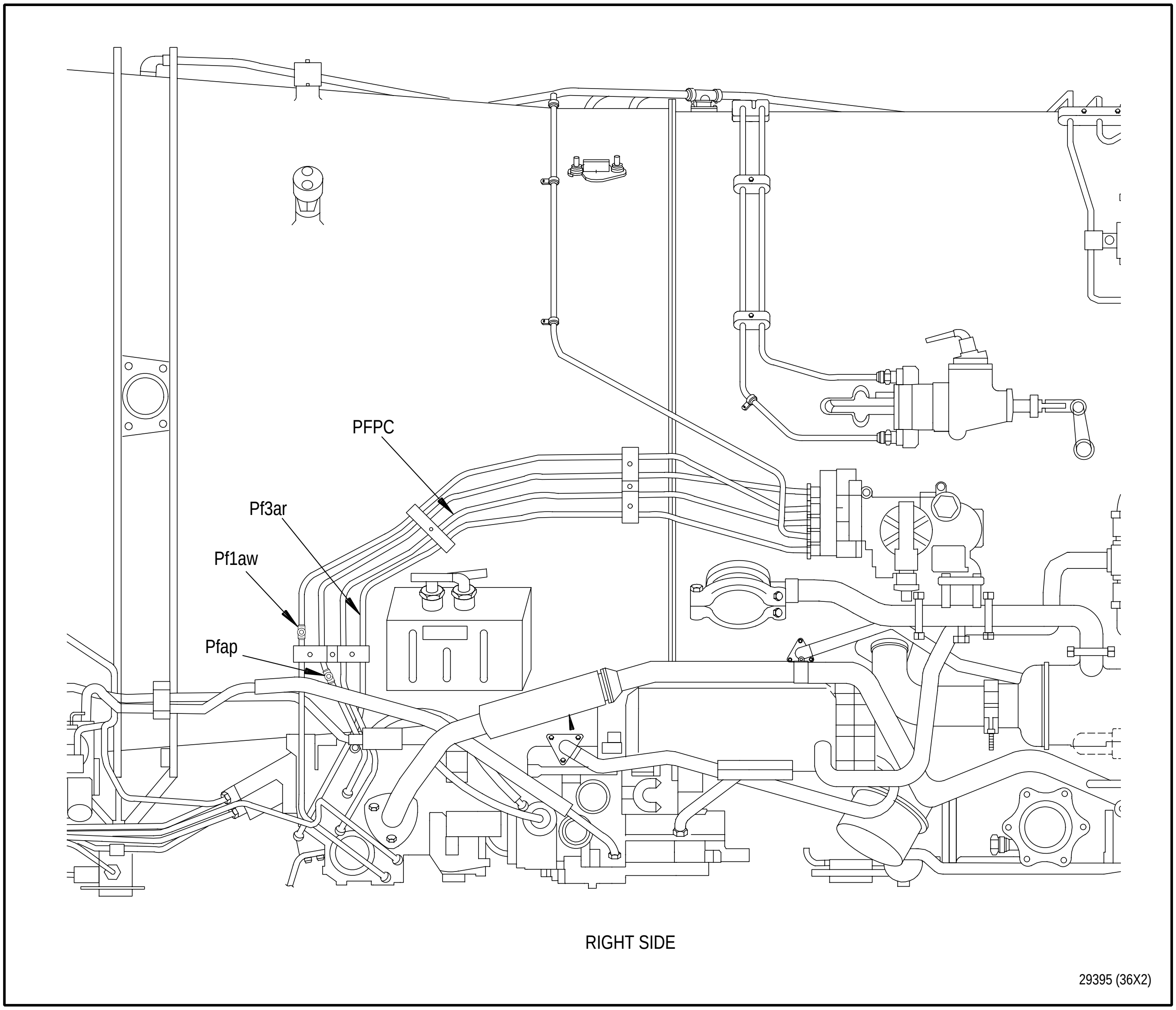


Figure 2. Augmentor Fuel System Diagnostic Pressure Taps

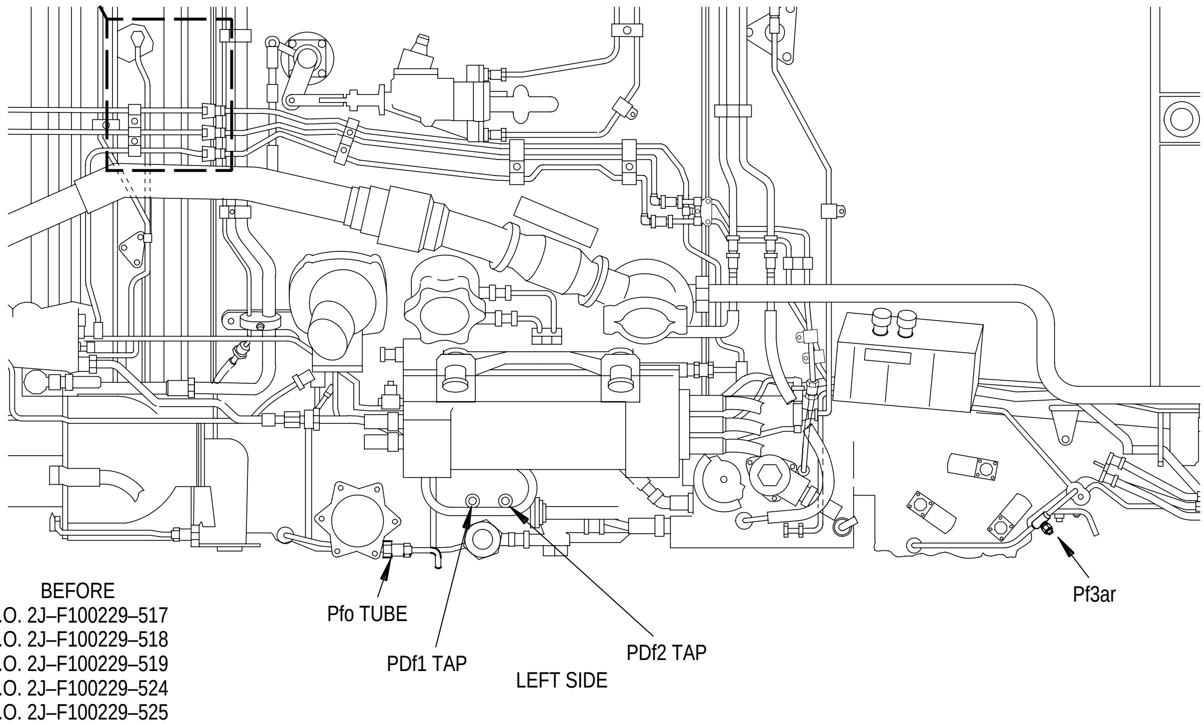


Figure 3. Main Fuel Pump Diagnostic Taps (Sheet 1 of 2)

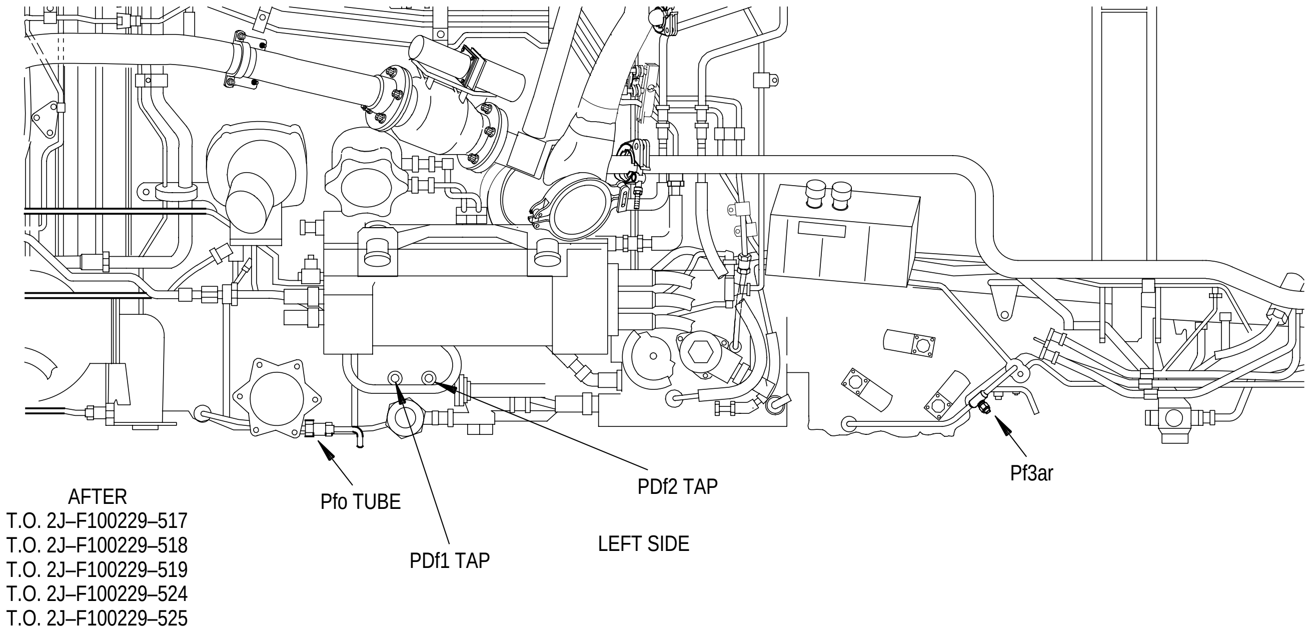


Figure 3. Main Fuel Pump Diagnostic Taps (Sheet 2 of 2)

WORK PACKAGE

TECHNICAL PROCEDURES

SEC MODE FUEL SYSTEM ANALYSIS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 12	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test ----------------------------------	T.O. 2J-F100-11-2
Engine Fuel System Contamination ---------------	WP 305 00
Engine Troubleshooting - General ---------------	WP 501 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

Nomenclature	Part Number	Quantity
Gasket	ST2229-04	2

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Secondary Mode Fuel System Analysis	
	Pressure test set	PWA 56038

ILLUSTRATED SUPPORT EQUIPMENT

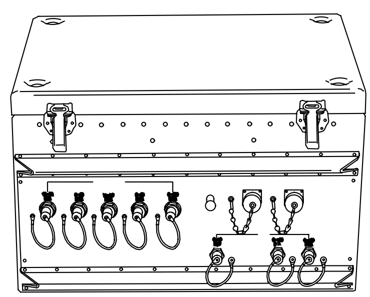


Figure T1. PWA 56038 Pressure Test Set

1. INTRODUCTION

a. This work package contains troubleshooting procedures for SEC mode fuel system analysis.

2. SEC MODE FUEL SYSTEM ANALYSIS.

(See Figures 1 and 2, and Tables 1 through 3.)

a. Connect PWA 56038 pressure test set as follows (see figure 1):

(1) Connect ground cable to GND lug on instrument case.

(2) Turn test set POWER switch OFF.

(3) Connect BH 27394 interconnect cable to interconnect receptacle on instrument case and to interconnect receptacle on display unit.

(4) Connect BH 27395 power cable to power receptacle on instrument case and to 115V, 60 to 400 Hz power source.

b. Calibrate PWA 56038 pressure test set per table 1.

c. Install Pfmo and Pfl pressure hoses as follows:

(1) Remove cap from Pfl diagnostic tap. (See figure 1.)

NOTE

The loop tee adapter, which is stored in the accessory case, is a detail of PWA 56038 pressure test set.

(2) Remove Pfmo tube from tee adjacent to AFC. (See figure 1.) Install loop tee adapter in Pfmo tube.

CAUTION

To prevent damage to test set, connect hoses to test set ports only as specified in this procedure.

(3) Connect PN BH27676 hose to Pfmo loop tee and No. 16 pressure port on instrument case.

(4) Connect PN BH27676 hose to PDf1 tap and No. 10 pressure port on instrument case.

d. Purge PWA 56038 pressure test set and diagnostic hoses per table 2.

e. Perform engine test to check Pfmo-Pf1 delta pressure. See table 3.

f. Disconnect pressure hoses as follows:

(1) Turn POWER switch OFF.

(2) Turn off fuel pump, tank valve, and regulator valve.

(3) Remove hoses from Pfmo loop tee adapter and Pf1 diagnostic tap.

(4) Remove other hose ends from No. 10 and No. 16 pressure ports on instrument case. Drain fuel from hoses and stow.

(5) Remove loop tee adapter from Pfmo tube.

(6) Install protective caps on instrument case ports.

(7) Install PN ST2229-04 conical gasket on PDf1 tap. Install cap and torque 90 to 100 pound-inches.

(8) Install PN ST2229-04 conical gasket on Pfmo tee. Install tube on tee and torque 90 to 100 pound-inches.

Table 1. Pressure Test Set

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
1.	Turn POWER switch ON.	XXXX THEN XXXX THEN XXXX THEN XXXX D.U. XXXX HRS. THEN I.C. XXXX HRS. THEN * * *READY* * *	a. Check that pressure test set is properly hooked up to external power source. b. Repair or replace pressure test set.

Table 1. Pressure Test Set (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
2.	Remove all protective caps from pressure ports on instrument case.		
3.	Press O ADJ button.	VENT ALL INPUTS	
4.	a. Press O ADJ button	ALL VENTED	a. Repair or replace pressure test set.
	b. Press O ADJ button	PUSHAGAINTOZERO	
	c. Press O ADJ button	NOW DOING O ADJ THEN O ADJ COMPLETE	

Table 2. Pressure Test Set Purging

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
1.	Connect purge line BH27677 to instrument box.		
2.	Move throttle to CUTOFF.		
3.	Turn test cell fuel pump switch ON.		
4.	Turn tank and regulator valves ON.		
5.	a. Select hose to be purged.	PURGE XXXX UNITS	
	b. Enter number to be purged.	##	
6.	Press and hold PURGE button and then press ENT buttons simultaneously. Purge until no air shows in fuel exiting purge line.	a. PURGE XXXX UNITS b. Reduced pressure indication with purge in progress. c. Fuel exits purge line.	Repair or replace pressure test set.
7.	Release PURGE and ENT buttons.		
8.	Repeat steps 5, 6, and 7 for each hose being purged.		

Table 3. Pfmo-Pf1 Delta Pressure Test

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
		CAUTION • When performing following test, do not exceed engine limits. • If measuring lines and equipment are not set up properly or if pressure lines are not bled properly, engine operation can be unstable.	
1.	Perform primary mode engine start.	Normal primary mode start.	If engine starts in SEC mode, continue to step 2. Otherwise, troubleshoot as required.
2.	Type in 53 on display unit.	53	
3.	Press ENT button	Pfmo - Pf1 is 0 to 30 psid.	a. Replace MFC mode select solenoid. b. If fuel pressure still out of limits, replace the MFC.
4.	Turn MODE SELECT switch to SEC.	Engine transfers to SEC mode: • SEC light on • ENP less than 5%	Troubleshoot as required.
5.	Check pressure reading on display unit.	Pfmo-Pf1 220 to 300 psid.	a. Replace MFC mode select solenoid. b. If fuel pressure still out of limits, replace the MFC.
6.	Turn MODE SELECT switch to PRIM.	a. Engine transfers to PRIM mode. b. Pfmo - Pf1 0 to 30 psid.	Troubleshoot as required.
7.	Shut down engine.		

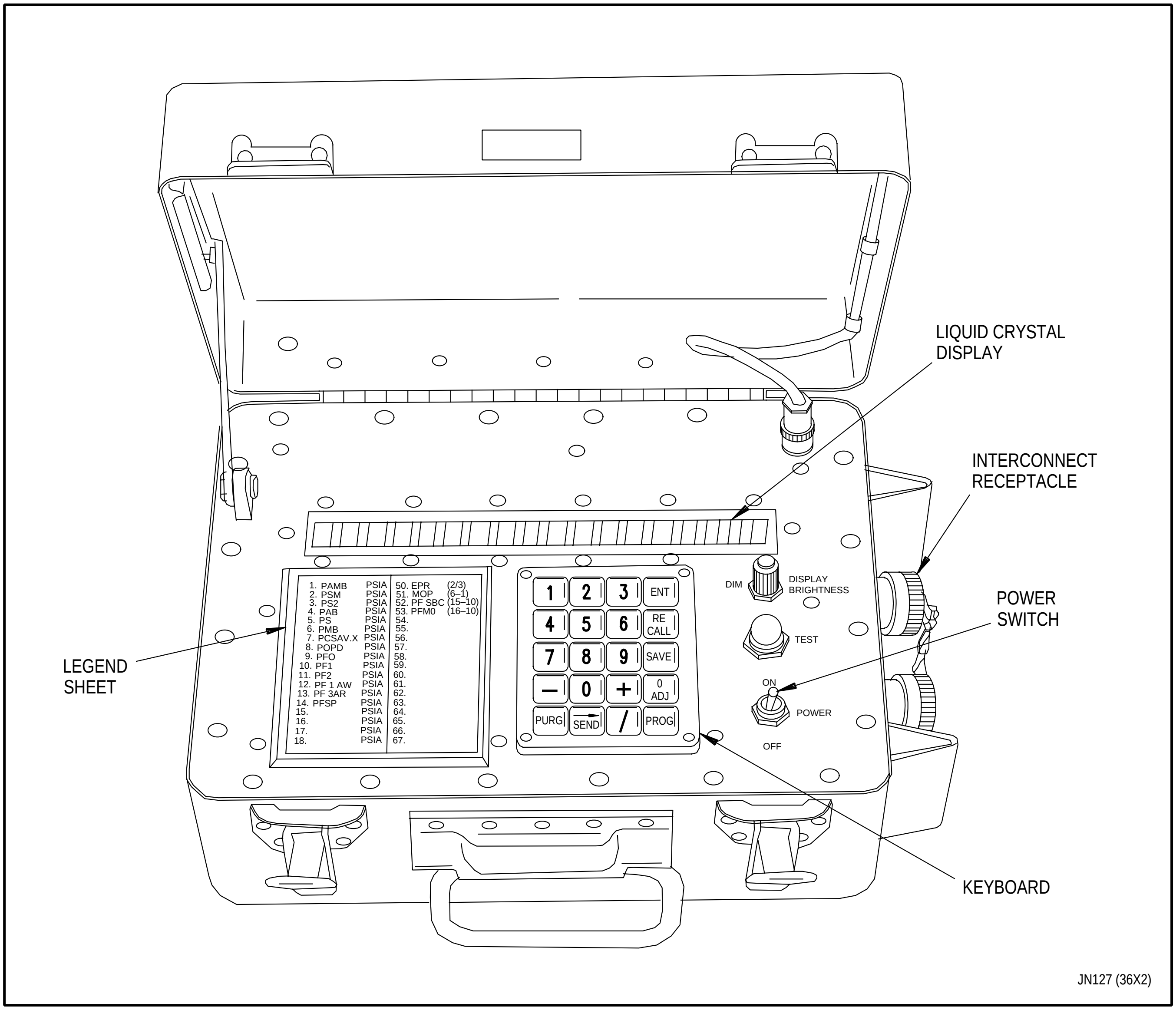


Figure 1. PWA 56038 Pressure Test Set (Sheet 1 of 3)

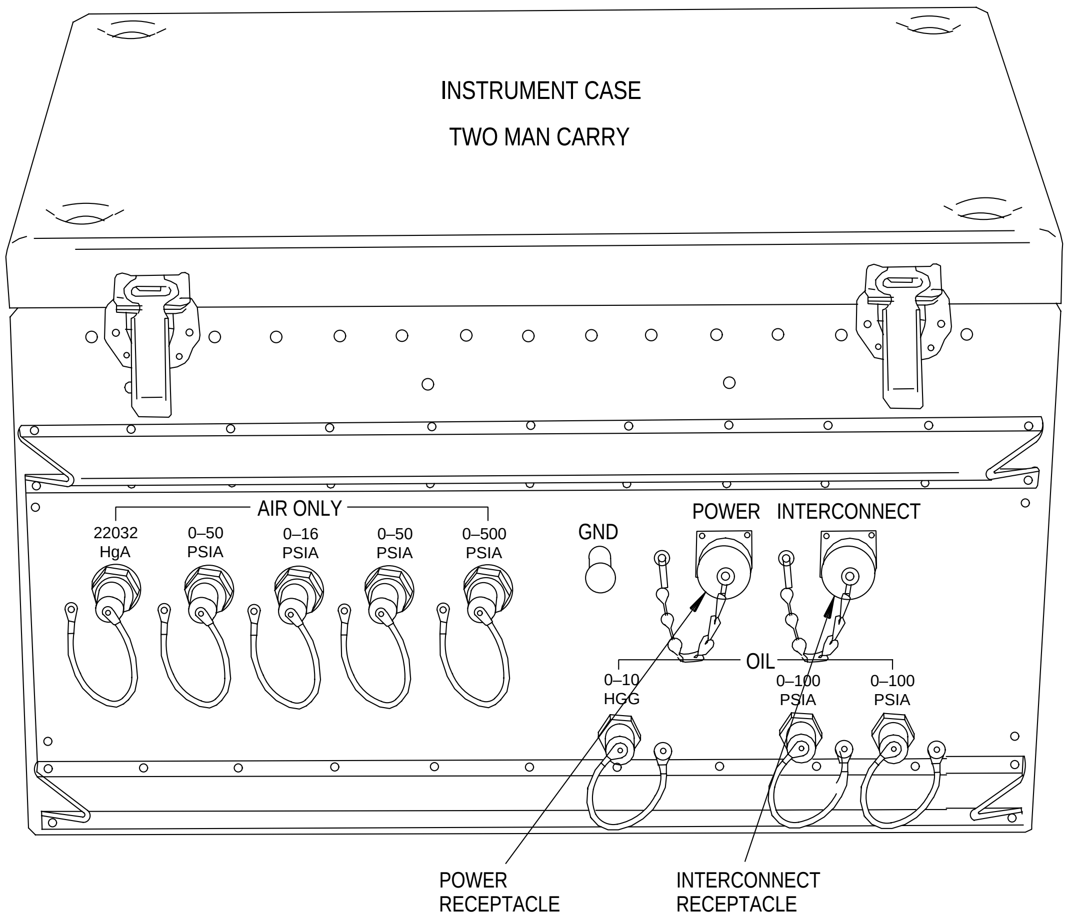


Figure 1. PWA 56038 Pressure Test Set (Sheet 2 of 3)

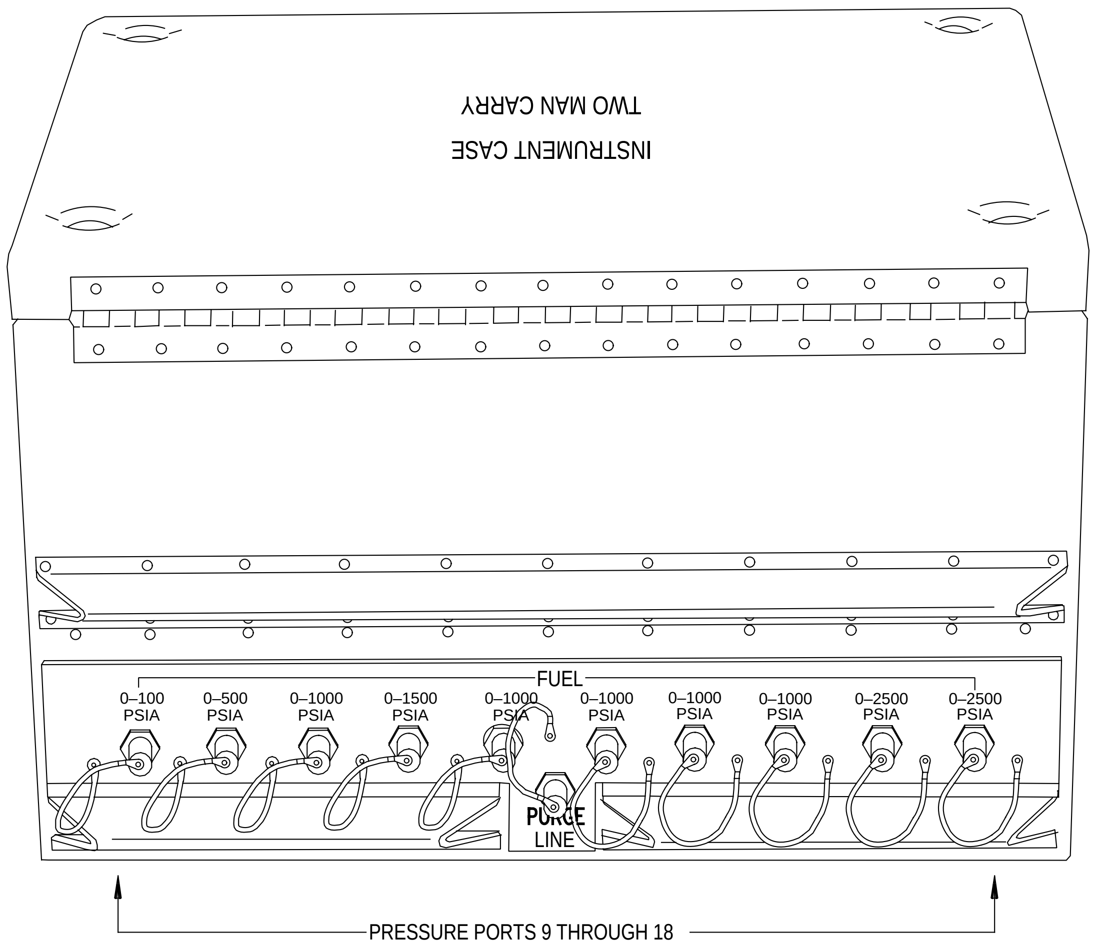


Figure 1. PWA 56038 Pressure Test Set (Sheet 3 of 3)

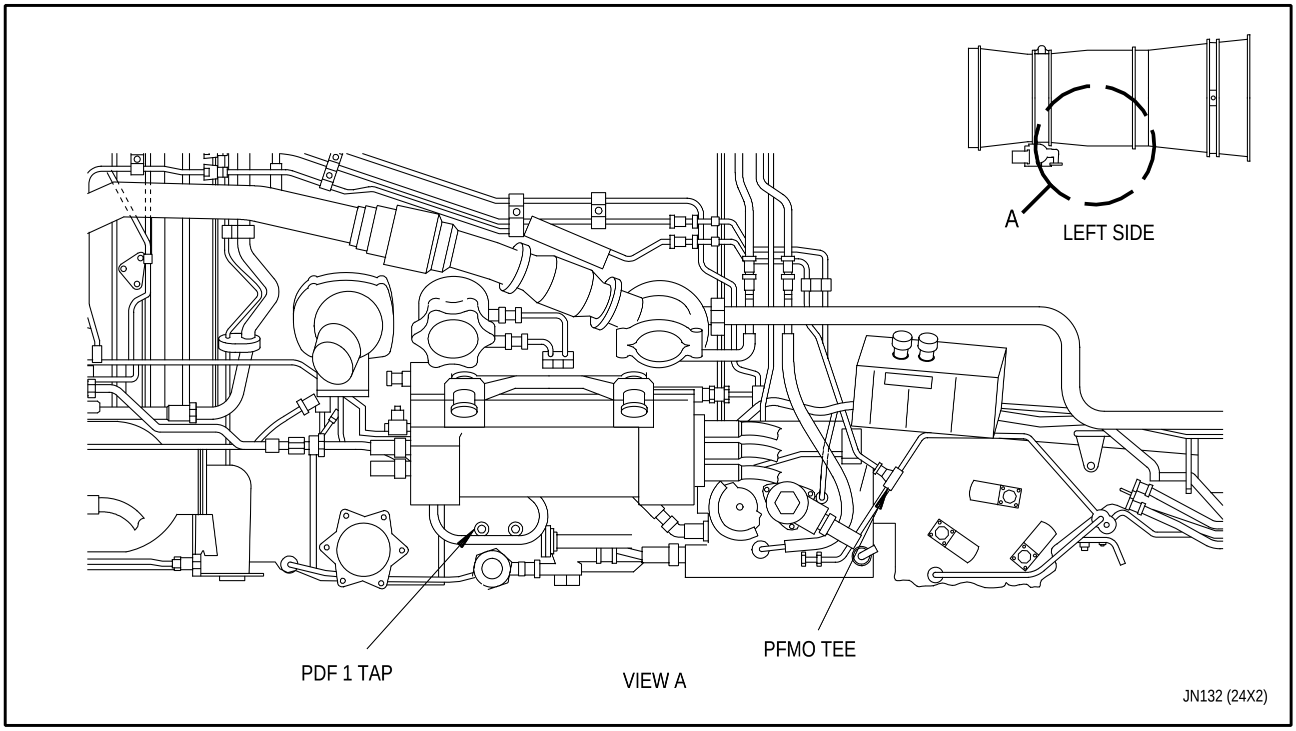


Figure 2. PDf1 and Pfmo - Diagnostic Taps

WORK PACKAGE

TECHNICAL PROCEDURES

IGNITION SYSTEM ANALYSIS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 50

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 2	20				
2A Added	20				
2B Blank Added	20				
3 - 4	20				
5 - 38	0				
39 - 40	20				
41 - 48 Added	20				

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Final Dress	WP 102 00
Engine Troubleshooting - General	WP 501 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Igniter - Spark, Gas Turbine Engine, Augmentor	WP 025 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	PWA 50025 IGNITION SYSTEM TEST SET (ISTS) - DESCRIPTION	
	TEST SET, IGNITION SYSTEM, A/E 24T-116	PWA 50025
	OHMMETER	PSM-6 OR EQUIVALENT
	ADAPTER KIT	PWA 62502
3	PRETEST FUNCTIONAL CHECK	
	ADAPTER KIT	PWA 62502
	OHMMETER	PSM-6 OR EQUIVALENT
	TEST SET, IGNITION SYSTEM, A/E 24T-116	PWA 50025
4	MAIN IGNITION SYSTEM ANALYSIS	
	TEST SET, IGNITION SYSTEM, A/E 24T-116	PWA 50025
	OHMMETER	PSM-6 OR EQUIVALENT
	ADAPTER KIT	PWA 62502

APPLICABLE SUPPORT EQUIPMENT (continued)

Paragraph	Function - Tool Nomenclature	Tool Number
5	AUGMENTOR IGNITION SYSTEM ANALYSIS	
	TEST SET, IGNITION SYSTEM, A/E 24T-116 --------	PWA 50025
	OHMMETER ------------------------------	PSM-6 OR EQUIVALENT
	ADAPTER KIT ----------------------------	PWA 62502
6	IGNITION SYSTEM ANALYSIS USING PN 137375 IGNITION SYSTEM TESTER	
	TESTER, IGNITION SYSTEM ------------------	PN 137375
	IGNITER END CAP, MAIN (DETAIL OF PWA 50025) ----	PWA 52174
	CAP, IGNITER AUGMENT (DETAIL OF PWA 62502) -----	PWA 56071

ILLUSTRATED SUPPORT EQUIPMENT

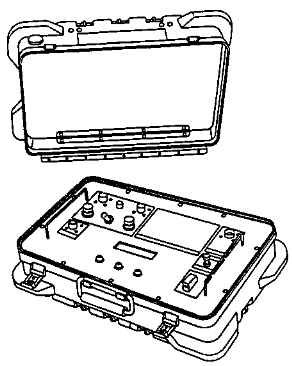


Figure T1. PN 137375 TESTER

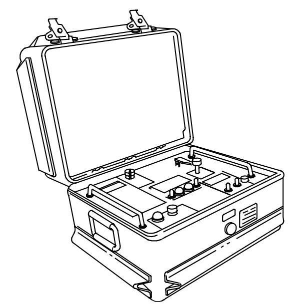


Figure T2. PWA 50025 TEST SET

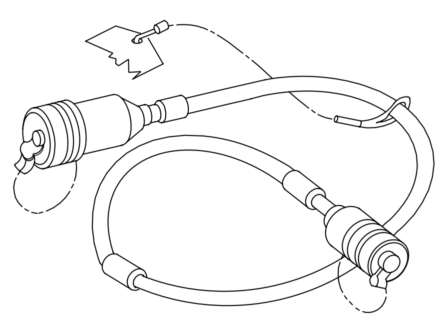


Figure T3. PWA 62502 ADAPTER KIT

1. INTRODUCTION

a. This work package contains troubleshooting procedures for ignition system analysis.

2. PWA 50025 IGNITION SYSTEM TEST SET (ISTS) - DESCRIPTION.

(See Figures 1 through 6.)

a. PWA 50025 ISTS is a portable unit with capability of checking out complete main and augmentor ignition systems. (See figure 1.)

b. A generator simulator provides power for testing, which eliminates need to motor engine.

c. An energy meter and sparks/ second counter are provided to monitor operation of ignition system components.

d. All tools, packings, plugs, and connectors called out in paragraphs 3, 4, and 5 are part of PWA 50025 test set and PWA 62502 Adapter Kit.

e. See system schematics in figures 2 through 6.

Legend for figure 1

1. Meter, RMS VOLTS
2. Sealing plug
3. Rotary switch, VOLTS ADJ, R28
4. Toggle switch, OUTPUT PWR, S4
5. Pilot light, PWR ON
6. Connector, 115V/400 Hz INPUT, J1
7. Protector cap and chain
8. Toggle switch, PWR ON, S1
9. Electronic scaler, SPARKS/SEC X 10 SEC
10. Toggle switch, MTR PWR, S2
11. Push button switch, START, S7
12. Push button switch, RESET, S8
13. Toggle switch, MAN, AUTO, S10
14. Toggle switch, MTR PWR, S3
15. Toggle switch, CAL ON, S9
16. Potentiometer, CAL ADJ, R1
17. Meter, STORED ENERGY
18. Connector, HIGH VOLTAGE INPUT, J2
19. Protector cap and chain
20. Actuator arm, S6
21. Rotary switch, EXC SEL, S5
22. Protector cap and chain
23. Connector, ALTERNATOR SIMULATOR OUTPUT, J3

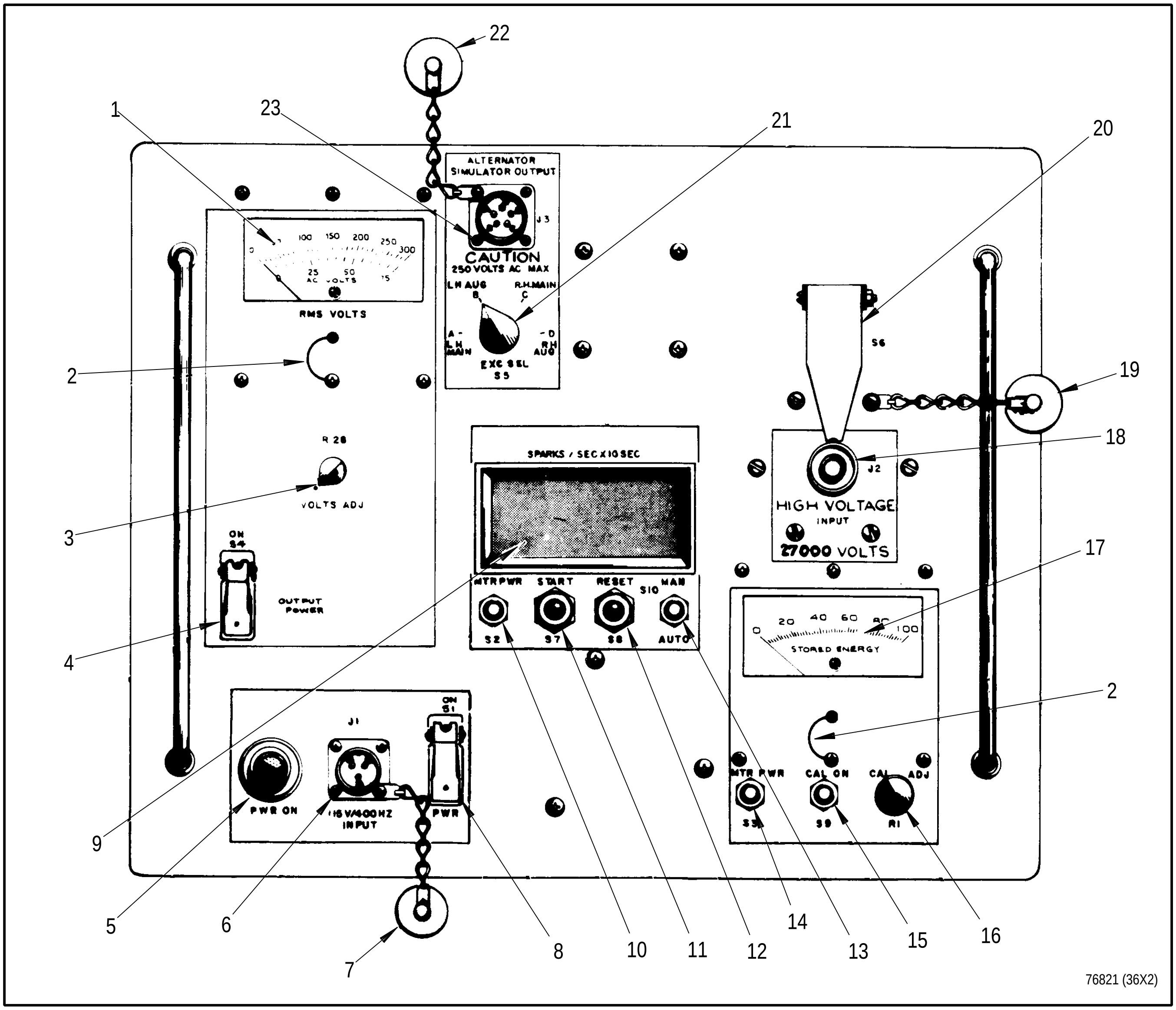
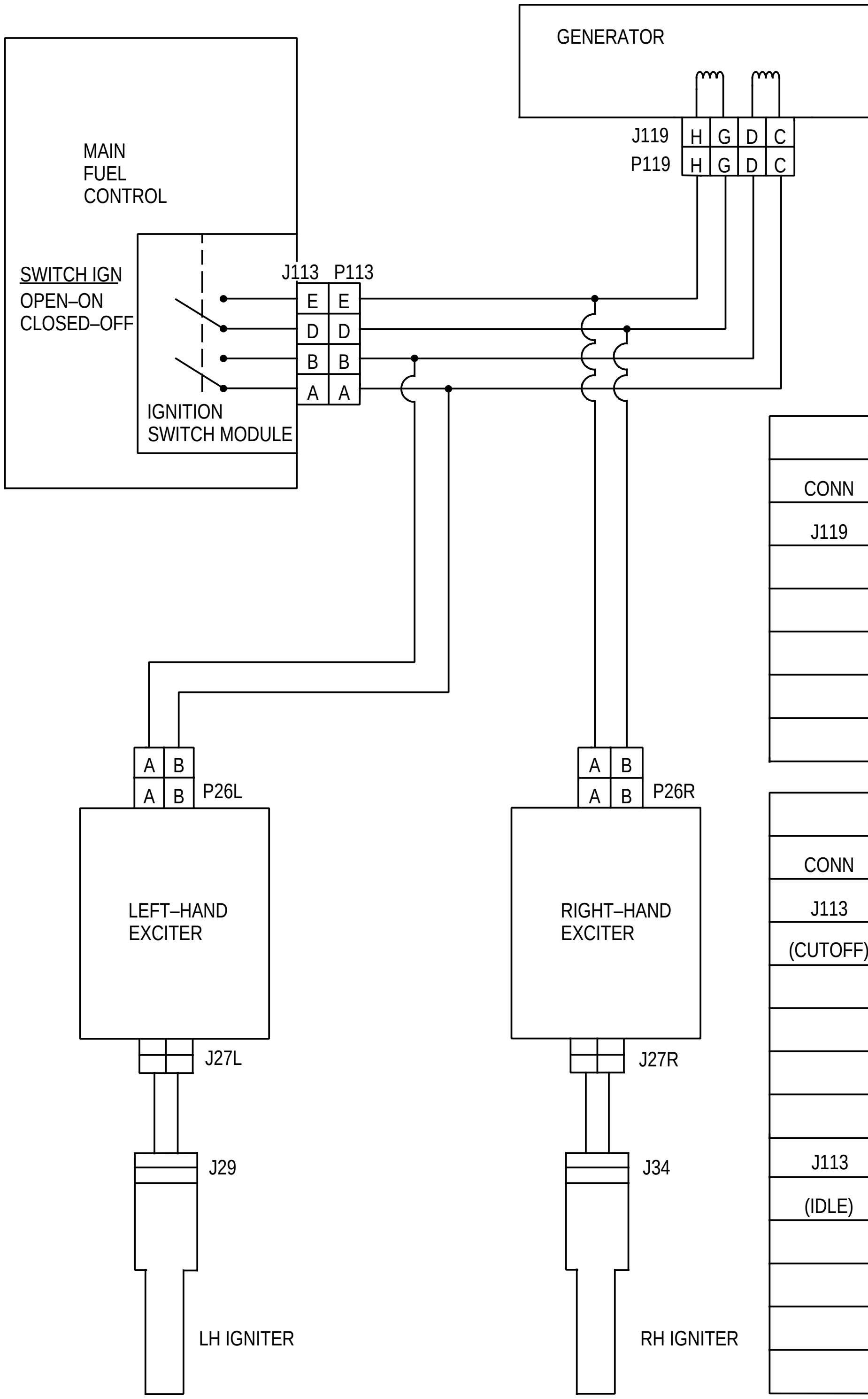


Figure 1. PWA 50025 Ignition System Test Set - Identification

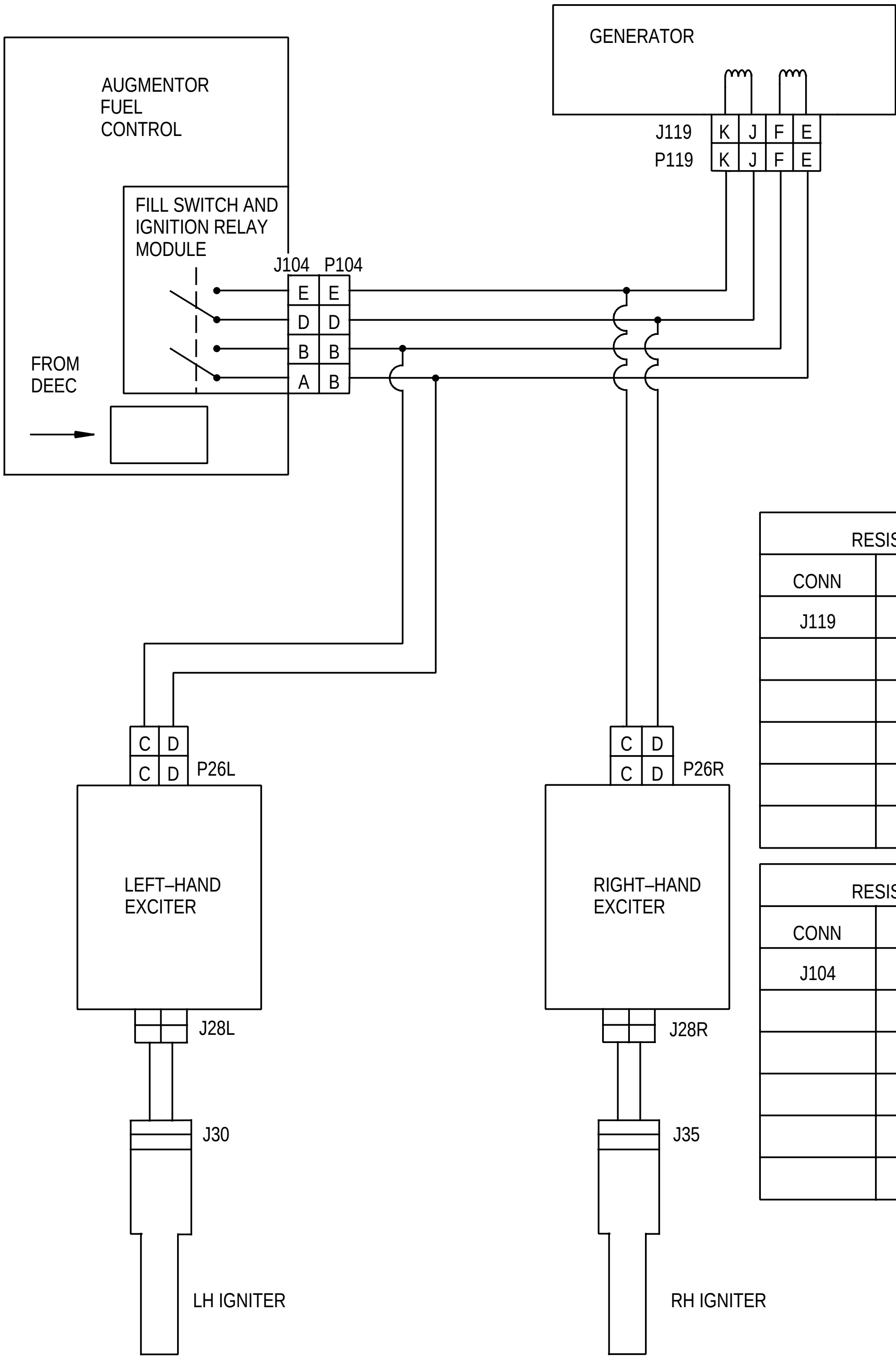


RESISTANCE LIMITS		
CONN	PINS	OHMS
J119	C–D	LT 10
	C–GND	GT 100,000
	D–GND	GT 100,000
	G–H	LT 10
	G–GND	GT 100,000
	H–GND	GT 100,000

RESISTANCE LIMITS		
CONN	PINS	OHMS
J113	C–D	LT 5
(CUTOFF)	A–GND	GT 100,000
	B–GND	GT 100,000
	D–E	LT 5
	D–GND	GT 100,000
	E–GND	GT 100,000
J113	A–B	GT 100,000
(IDLE)	A–GND	GT 100,000
	B–GND	GT 100,000
	D–E	GT 100,000
	D–GND	GT 100,000
	E–GND	GT 100,000

JN161 (51X2)

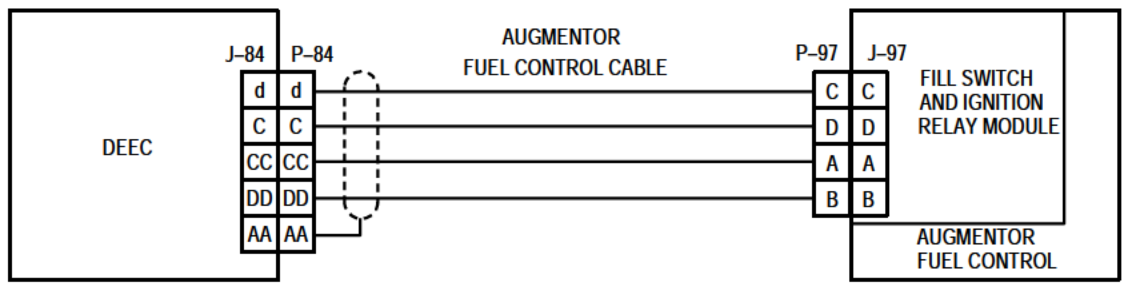
Figure 2. Gas Generator/MFC Ignition System Schematic - Resistance Check



RESISTANCE LIMITS		
CONN	PINS	OHMS
J119	E–F	LT 25
	E–GND	GT 100,000
	F–GND	GT 100,000
	J–K	LT 25
	J–GND	GT 100,000
	K–GND	GT 100,000

RESISTANCE LIMITS		
CONN	PINS	OHMS
J104	A–B	LT 5
	A–GND	GT 100,000
	B–GND	GT 100,000
	D–E	LT 5
	D–GND	GT 100,000
	E–GND	GT 100,000

Figure 3. Augmentor Ignition System Schematic - Generator Stator and AFC Ignition Switch - Resistance Check



FILL SWITCH NORMALLY CLOSED. SWITCH OPENS DURING AUGMENTOR QUICKFILL FOR EACH OF THE FIVE SEGMENTS.

IGNITION RELAY RESISTANCE LIMITS		
PINS (P–84)	PINS (J–97)	OHMS
CC–DD	A–B	200–400
CC–GND	A–GND	GT 100,000
DD–GND	B–GND	GT 100,000
d–C	C–D	LT 5
d–GND	C–GND	GT 100,000
C–GND	D–GND	GT 100,000
CC–AA		GT 100,000
DD–AA		GT 100,000
C–AA		GT 100,000
d–AA		GT 100,000

JN138 (30X2)

Figure 4. Augmentor Fuel Control Fill Switch and Ignition Relay Circuit

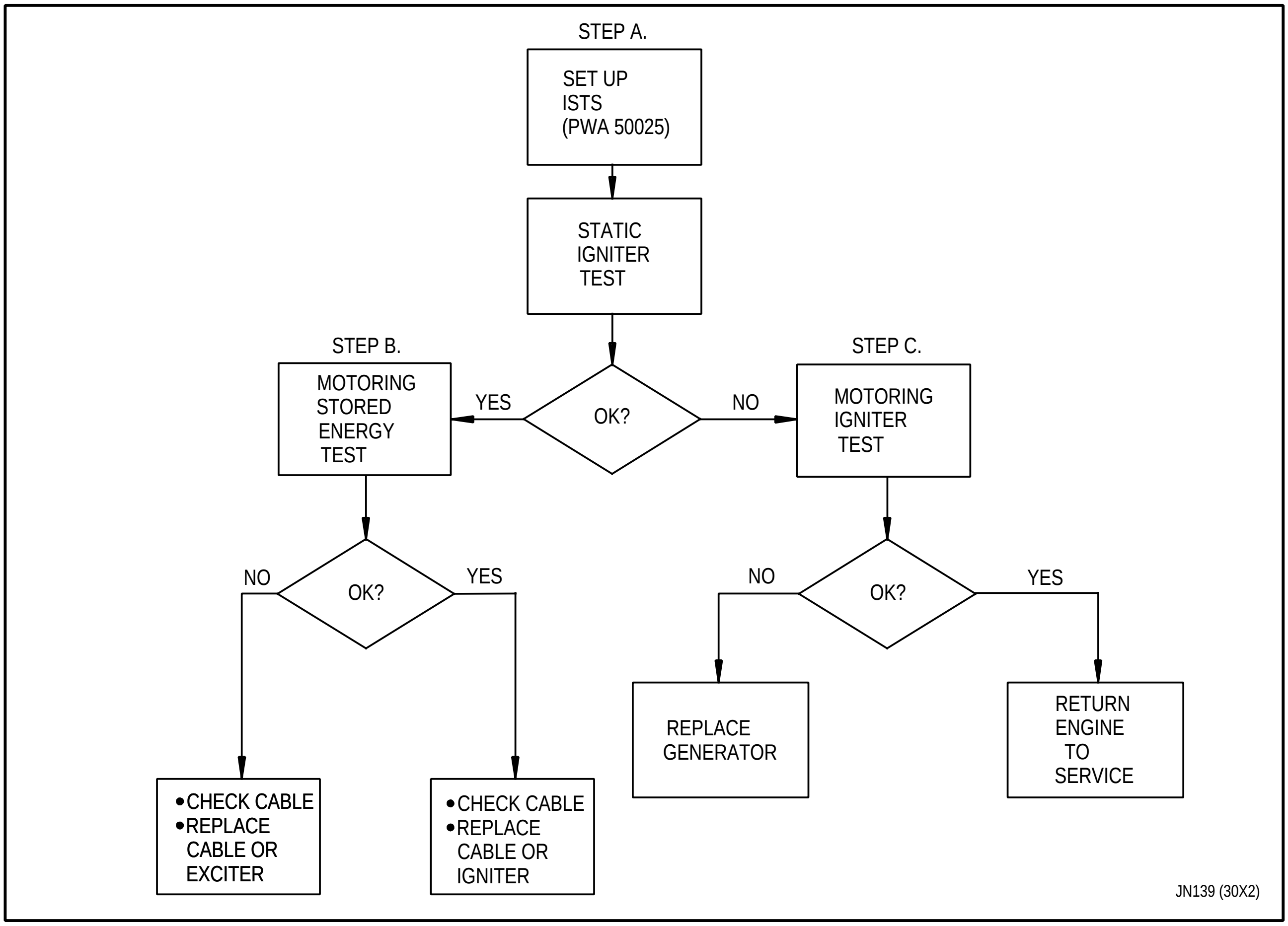


Figure 5. Main Ignition System Analysis Procedure Schematic

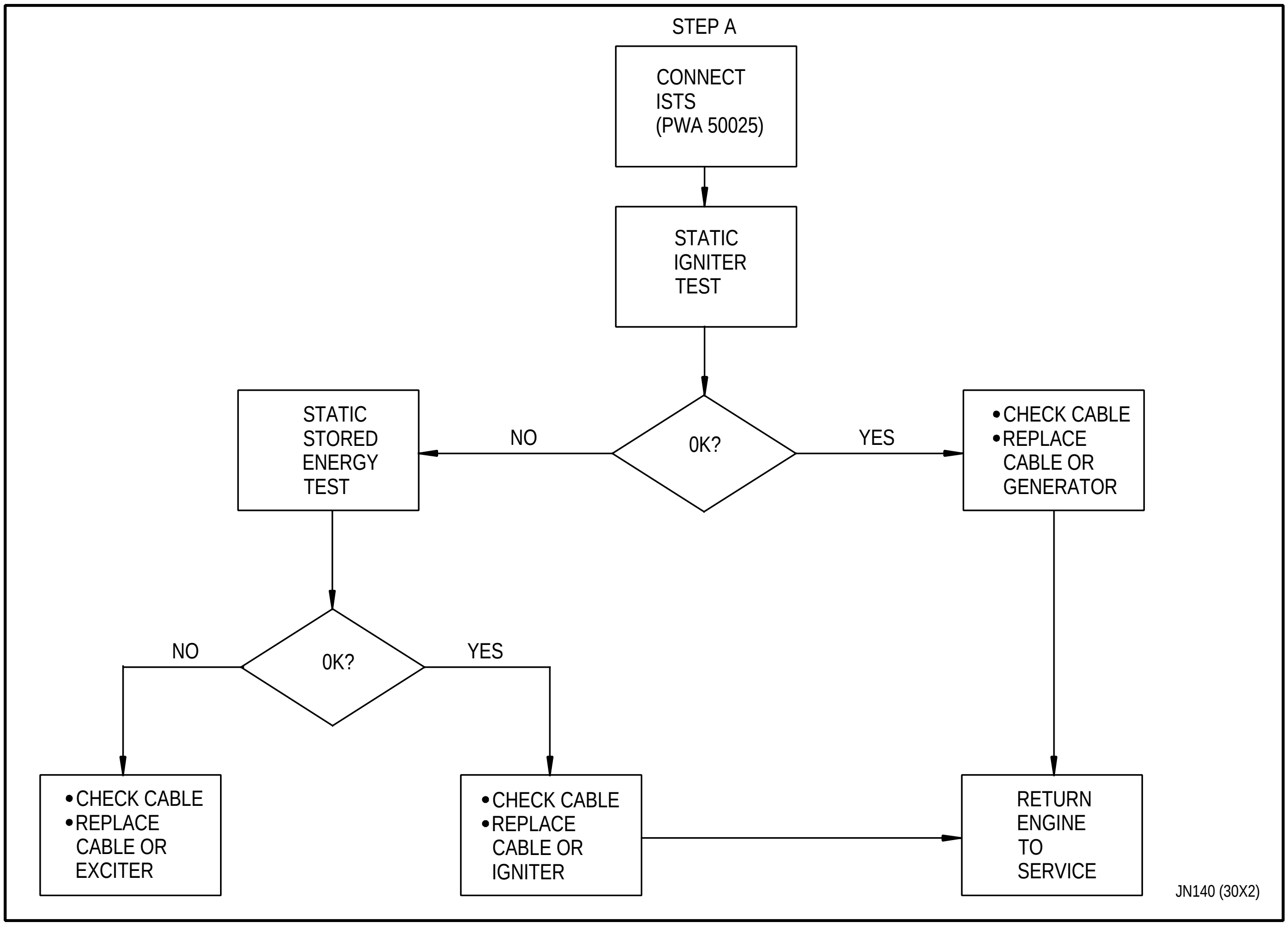


Figure 6. Augmentor Ignition System Analysis Procedure Schematic

3. PRETEST FUNCTIONAL CHECK.

(See figure 1 and Table 1.)

a. Perform PWA 50025 ISTS pretest functional check per table 1.

Table 1. Ignition System Analysis - Pretest Functional Check

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
1.	Connect ISTS to 115v/ 400 Hz power source. Connect power cable to ISTS J1 connector.		
2.	Install PWA 52185.		

WARNING

Ensure ISTS is properly grounded to engine being tested and to power source.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
3.	Turn PWR switch ON.	a. Red PWR ON light illuminated.	a.1. Check power source for output. a.2. Ensure power cable is connected properly. a.3. Repair/replace ISTS.
4.	Turn stored energy MTR POWER switch ON.		
5.	Turn CAL ON switch CAL ON.	Stored energy meter indicates 60 joules.	Turn CAL ADJ knob to obtain 60 joules.
6.	Turn CAL ON switch OFF.	Stored energy meter indicates 0 joules.	Repair/replace ISTS.
7.	Turn stored energy MTR PWR switch OFF.		
8.	Turn spark counter MTR PWR switch ON.		
9.	Turn MAN/AUTO switch MAN.		

Table 1. Ignition System Analysis - Pretest Functional Check (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
10.	Depress and release RESET button.	a. Display indicates 0.	a.1. Turn METER POWER OFF and repeat steps 5, 6, and 7. a.2. Repair/replace ISTS.
11.	Depress and release START button.	a. Display light goes OUT after ten second count.	a.1. Repeat steps 7 and 8. a.2. Repair/replace ISTS.
12.	Position spark counter MTR PWR switch to OFF.		

CAUTION

Do not operate generator simulator output for greater than 24 seconds for augmentor ignition circuit and 5 minutes for main ignition circuit.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
13.	Position OUTPUT PWR switch to ON.		
14.	Rotate VOLTS ADJ knob to full clockwise position.	RMS VOLTS display indicates full voltage.	Repair/replace ISTS.
15.	Rotate VOLTS ADJ knob to full counterclockwise position.	RMS VOLTS display indicates zero voltage.	Repair/replace ISTS.
16.	Position power output PWR MTR switch to OFF.		
17.	If main ignition system analysis is to be performed go to step c.		
18.	If augmentor ignition system analysis is to be performed go to step d.		

4. MAIN IGNITION SYSTEM ANALYSIS.
(See Figures 7 through 9 and Table 2.)

a. Perform main ignition system analysis per table 2.

Table 2. Main Ignition System Analysis

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
A.	STATIC CHECKS - LH AND RH IGNITERS.		
1.	Remove LH and RH gas generator igniters from engine.		
2.	Inspect igniters.	Igniters within limits.	Replace igniter.
3.	Reconnect both igniters to ignition cables.		
4.	Install PWA 52174 protective plastic covers using PN MS27513-210 packings on both igniters.		
5.	Remove P119 connector from generator. Check P119 and J119 connectors for damage, arcing, or contamination.	a. No contamination present.	a. Clean with approved alcohol or freon degreaser.
		b. No damage present.	b. Replace stator generator or ignition cable as required.
6.	Connect PWA 62502-1 adapter cable to PWA 52169 test lead cable.		

Table 2. Main Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
A. 7.	Connect PWA 62502-1 cable to P119 on ignition cable. Connect PWA 52169 test lead to J3 connector on ISTS.		

CAUTION

Do not operate generator simulator output for extended periods because internal simulators are subject to full current. When operating augmentor circuit, do not exceed duty cycle of 24 seconds maximum ON, 25 minutes minimum OFF. When operating gas generator circuit, do not exceed 5 minutes ON, 5 minutes minimum OFF. If these duty cycles are exceeded, engine exciter will be damaged and test set may shut down due to overheating.

NOTE

Interlock switch shall be activated anytime generator simulator is to supply power to ignition system. PWA 52185A interlock cap may be used in place of PWA 52234 high tension lead.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
8.	Connect PWA 52234 cable to J2 connector on ISTS. Do not connect other end of cable.	Interlock switch is down (activated).	Further engage PWA 52234 cable or install PWA 52185A interlock cap.
9.	Turn OUTPUT PWR switch ON.		
10.	Position EXC SEL switch to A-L.H. MAIN.		
11.	Rotate VOLTS ADJ knob clockwise to obtain 24.5 volts.	a. RMS VOLTS indicator displays 24.5 volts.	a. Adjust knob as required to obtain 24.5 volts.
		b. Igniter does not spark.	b. Replace MFC ignition switch module.
12.	Advance throttle slowly to IDLE detent.	a. Igniter begins to spark at IDLE.	a.1. Check throttle rigging.
			a.2. If within limits, replace MFC ignition switch module.

Table 2. Main Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
A. 13.	Observe LH igniter sparking for approximately 10 seconds. Check for proper arcing path and color. See figure 10.	Igniter sparks properly.	Go to step 14.
14.	Slowly retard throttle to CUTOFF.	a. Igniter stops sparking.	a.1. Check throttle rigging. a.2. If within limits, replace MFC ignition switch module.
15.	Rotate VOLTS ADJ knob to full counterclockwise position.	RMS VOLTS indicator displays 0 volts.	Repair/replace ISTS.
16.	Position EXC SEL switch to C-R.H. MAIN position.		
17.	Rotate VOLTS ADJ knob clockwise to obtain 24.5 RMS volts.	a. RMS VOLTS displays 24.5 volts. b. Igniter does not spark.	a. Adjust knob as required to obtain 24.5 volts. b. Replace MFC ignition switch module.
18.	Advance throttle slowly to IDLE detent.	a. Igniter begins to spark by Idle PLA.	a.1. Check throttle rigging. a.2. If within limits, replace MFC ignition switch module.
19.	Observe RH igniter sparking for approximately 10 seconds. Check for proper arcing path and color. See figure 10.	Igniter sparks properly.	Continue to step 22.
20.	Slowly retard throttle to CUTOFF.	a. Igniter stops sparking.	a.1. Check throttle rigging. a.2. If within limits, replace MFC ignition switch module.
21.	Rotate VOLTS ADJ knob to full counterclockwise position.	RMS VOLTS indicator displays 0 volts.	Repair/replace ISTS.

Table 2. Main Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
A. 22.	a. If both igniters pass the Static Test, proceed to step B - Generator Motoring Check. b. If either left or right hand igniter fails the Static Test, proceed to step C.		
B.	GENERATOR MOTORING CHECK - Step A Successful. (See figure 11.)		
1.	Remove ignition cable P119 connector from PWA 62502-1 adapter cable.		
2.	Connect P119 to J119 on generator.		
3.	Remove P113 connector from MFC.		
4.	Connect cap assembly, PWA 62502-5, to J113 on MFC.		

CAUTION

Do not advance throttle from CUTOFF position. Fuel may fog from exhaust nozzle and may enter test cell areas. Discontinue motoring if fuel fogs from exhaust nozzle and troubleshoot.

NOTE

Igniters should still be in plastic protectors.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
5.	Motor engine at approximately 2100 to 2800 N2 rpm.	a. Both igniters spark properly. Proceed to steps 6 and 7.	a.1. Replace generator stator. Repeat step b.

Table 2. Main Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
B.5. (cont'd)			a.2. If igniters still do not spark, replace generator rotor.
6.	Discontinue motoring.		
7.	Check main igniter immersion depth.	Igniter immersion depth within limits.	Reinstall igniters with proper classified spacer.
8.	Remove plastic protective covers from igniters.		
9.	Reinstall igniters.		
10.	Remove cap assembly from J113 and reconnect to P113 to MFC.		
11.	Return engine to service.		
C.	EXCITER MOTORING CHECK - Step A Successful. (See figure 11.)		
1.	Disconnect P29 connector from left-hand (LH) igniter.		

Table 2. Main Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication

WARNING

- Ignition exciter voltage is deadly. Exciter shall be completely discharged before performing maintenance.
- Ground output lead of PWA 52176 grounding cable to unpainted screw head or to exciter mount bracket on engine.

CAUTION

- Do not discharge exciter by sparking to ground. Internal damage to exciter may occur unless initial discharge is through resistor.
- Coiling high tension lead into less than a 10-inch circle can cause cable damage.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
C. 2.	Use PWA 52176 grounding cable to discharge LH exciter. Use resistor lead first; then use ground lead for one minute each.		
3.	Connect PWA 52234 cable to P29 connector on LH exciter-to-igniter cable and to J2 on ISTS.		
4.	Remove P113 connector from MFC.		
5.	Connect PWA 62502-5 cap assembly to J113.		
6.	Position spark counter meter MTR PWR switch to ON.		
7.	Ensure MAN/AUTO switch is in MAN position.		
8.	Depress and release reset button.	Spark counter displays 0.	

Table 2. Main Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
C. 9.	Position stored energy MTR PWR switch to ON.		
10.	Position CAL ON switch to ON position.	Stored energy meter displays 60 joules.	Adjust CAL ADJ knob to obtain a display value of 60 joules.
11.	Position CAL ON switch to OFF position.	Stored energy meter displays 0 joules.	

CAUTION

Do not advance throttle from CUTOFF position. Fuel will fog from exhaust nozzle and may enter test cell area. Discontinue motoring if fuel fogs from exhaust nozzle and troubleshoot.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
12.	Motor engine at approximately 2100 to 2800 N2 rpm.	a. Stored energy meter value 50 to 63 joules.	a.1. Check exciter-to-igniter cable continuity. a.2. Check ignition cable for continuity. a.3. If both check within limits, replace LH exciter.
		b. RH exciter sparking.	b. Check RH ignition. Go to step 17.
13.	Depress and release START button.	a. After 10 seconds, spark counter displays 10 to 50.	a.1. Check exciter-to-igniter cable continuity. a.2. Check ignition cable continuity. a.3. If both check within limits, replace LH exciter.
14.	Discontinue motoring.		
15.	Disconnect PWA 52234 cable from P29 connector on exciter-to-igniter cable.		

Table 2. Main Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication

WARNING

- Ignition exciter voltage is deadly. Exciter shall be completely discharged before performing maintenance.
- Ground output lead of PWA 52176 grounding cable to unpainted screw head or to exciter mount bracket on engine.

CAUTION

- Do not discharge exciter by sparking to ground. Internal damage to exciter may occur unless initial discharge is through resistor.
- Coiling high tension lead into less than a 10-inch circle can cause cable damage.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
16.	Use PWA 52176 grounding cable to discharge RH exciter. Use resistor lead first; then use ground lead for one minute each.		
17.	Reconnect P29 to LH igniter. Ensure plastic protective cover is installed.		
18.	Disconnect P29 connector from RH igniter.		

Table 2. Main Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication

WARNING

- Ignition exciter voltage is deadly. Exciter shall be completely discharged before performing maintenance.
- Ground output lead of PWA 52176 grounding cable to unpainted screw head or to exciter mount bracket on engine.

CAUTION

- Do not discharge exciter by sparking to ground. Internal damage to exciter may occur unless initial discharge is through resistor.
- Coiling high tension lead into less than a 10-inch circle can cause cable damage.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
19.	Use PWA 52176 grounding cable to discharge RH exciter. Use resistor lead first; then use ground lead for one minute each.		
20.	Connect PWA 52234 cable to P29 connector on RH exciter-to-igniter cable.		
21.	Depress and release RESET button.	Spark counter displays 0.	

Table 2. Main Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication

CAUTION

Do not advance throttle from CUTOFF position. Fuel will fog from exhaust nozzle and may enter test cell area. Discontinue motoring if fuel fogs from exhaust nozzle and troubleshoot.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
C. 22.	Motor engine at approximately 2100 to 2800 N2 rpm.	a. Stored energy meter value 50 to 63 joules.	a.1. Check exciter-to-igniter cable continuity. a.2. Check ignition cable for continuity. a.3. If both check within limits, replace RH exciter.
		b. LH exciter sparking.	
23.	Depress and release START button.	a. After 10 seconds, spark counter displays 10 to 50.	a.1. Check exciter-to-igniter cable continuity. a.2. Check ignition cable continuity. a.3. If both check within limits, replace RH exciter.
24.	Discontinue motoring.		
25.	Disconnect PWA 52234 cable from P29 connector on exciter-to-igniter cable.		

Table 2. Main Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication

WARNING

- Ignition exciter voltage is deadly. Exciter shall be completely discharged before performing maintenance.
- Ground output lead of PWA 52176 grounding cable to unpainted screw head or to exciter mount bracket on engine.

CAUTION

- Do not discharge exciter by sparking to ground. Internal damage to exciter may occur unless initial discharge is through resistor.
- Coiling high tension lead into less than a 10-inch circle can cause cable damage.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
C. 26.	Use PWA 52176 grounding cable to discharge RH exciter. Use resistor lead first; then use ground lead for one minute each.		
27.	Reconnect P29 to LH exciter.		
28.	Remove cap assembly from J113. Reconnect P113 to J113 on MFC.		
29.	Reinstall LH and RH igniters.		

Table 2. Main Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
D.	POSTTEST PROCEDURE.		
1.	Turn all POWER switches OFF.		
2.	Disconnect PWA 52234 cable from J2 on ISTS. Stow cable.		
3.	Disconnect PWA 52166 cable from power source and J1 on ISTS. Stow cable.		
4.	Stow plastic protective covers and open circuit connector.		
5.	Reinstall lid on ISTS.		

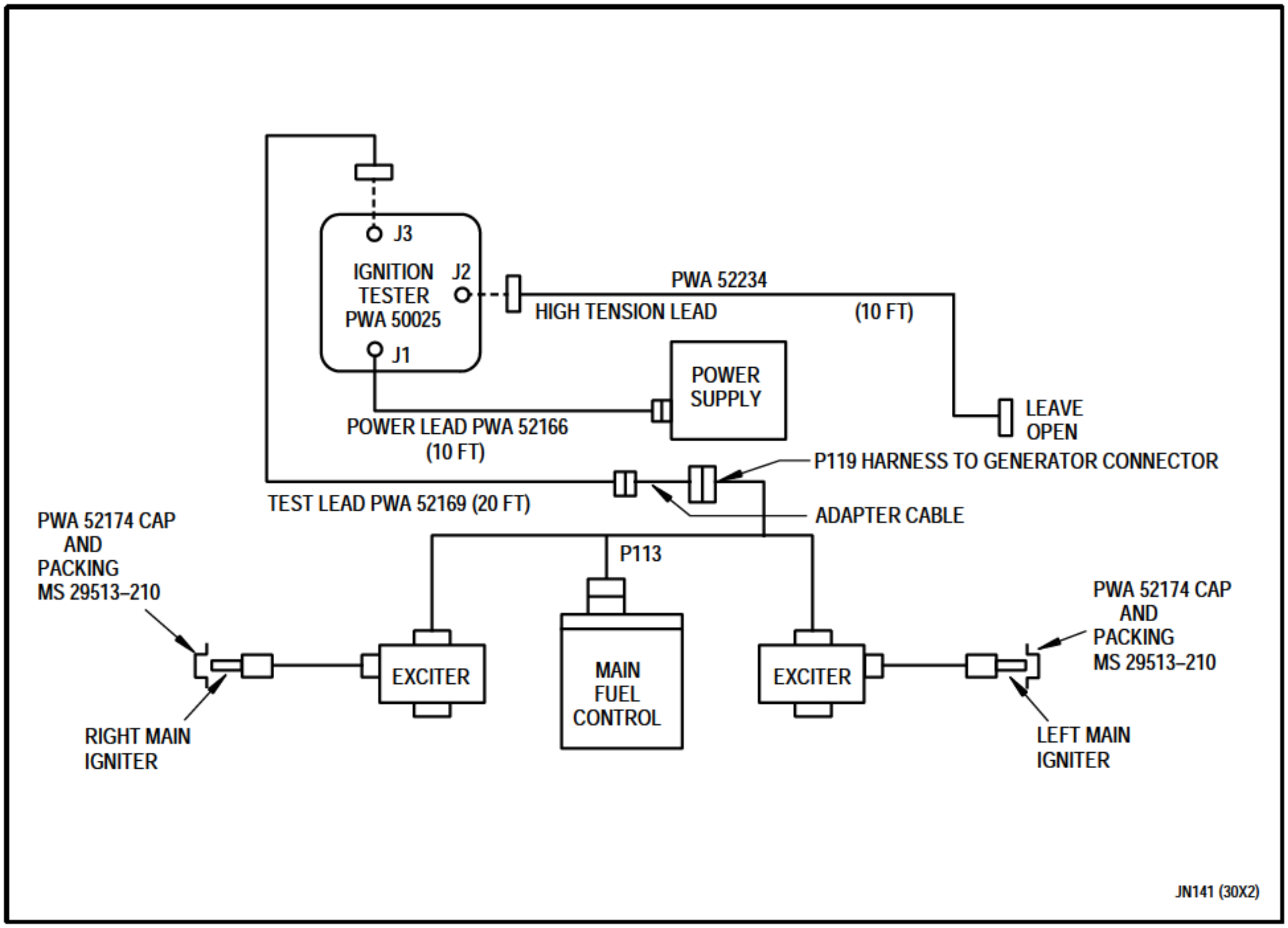


Figure 7.   Main Ignition System - Static Check Procedure

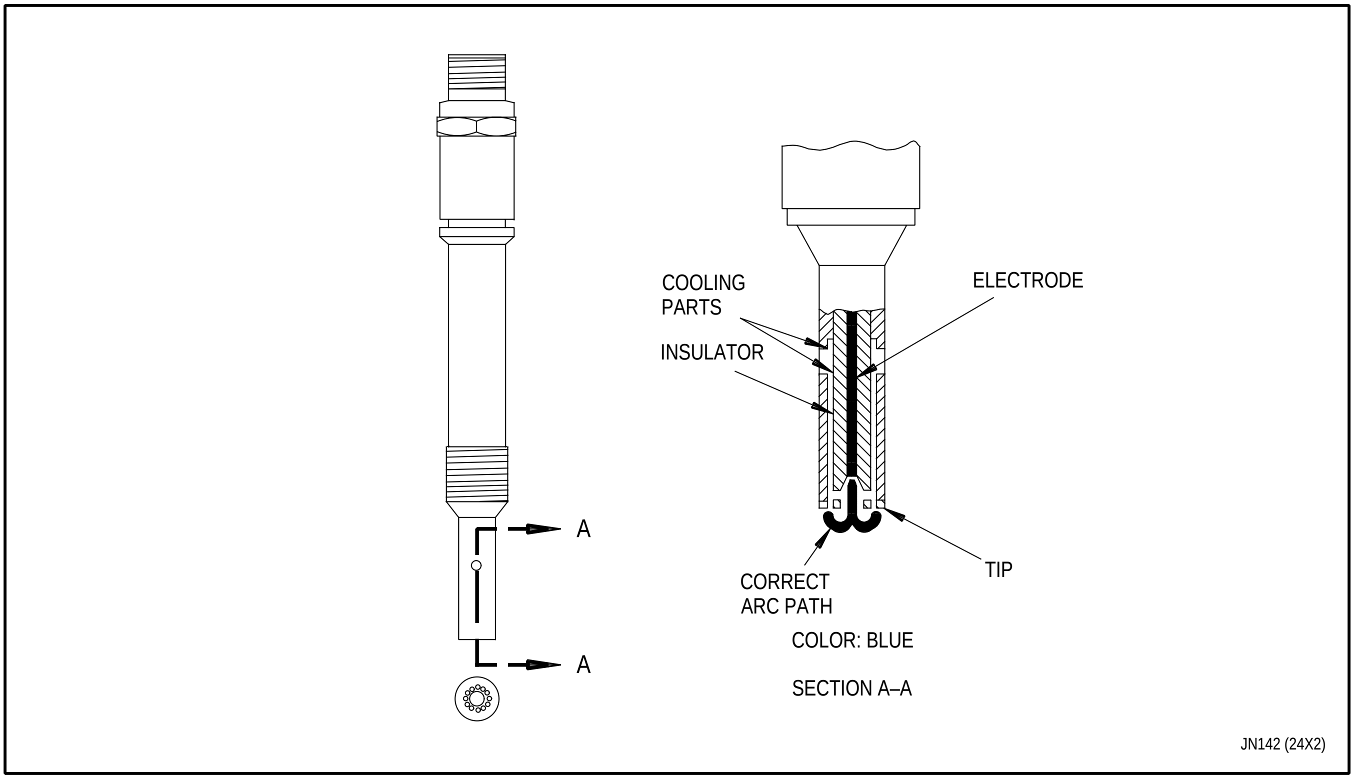


Figure 8. Igniter - Arc Path

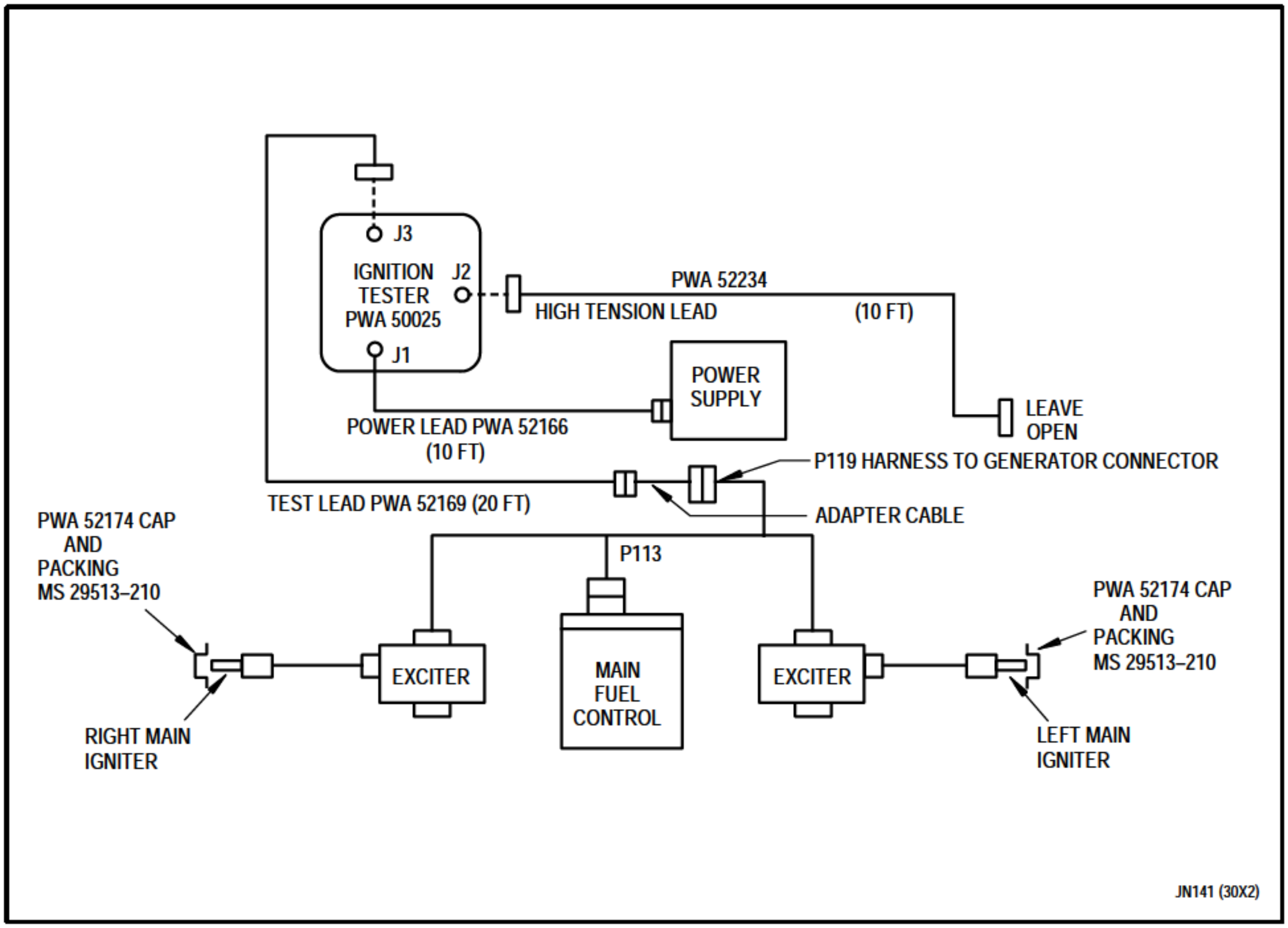


Figure 9. Main Ignition System - Motoring Check Procedure

5. AUGMENTOR IGNITION SYSTEM ANALYSIS.
(See figures 8 and 9, and Figures 10 and 11, and Table 3.)

a. Perform augmentor ignition system analysis. Refer to table 3.

Table 3. Augmentor Ignition System Analysis

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
A.	STATIC CHECKS - LH AND RH AUGMENTOR IGNITERS.		
1.	Remove left and/or right-hand igniters from engine.		
2.	Inspect igniters.	Igniters within limits.	Replace igniter.
3.	Reconnect igniters to ignition cable.		
4.	Install PWA 56071 protective plastic covers using PN MS29513-218 packings on both augmentor igniters.		
5.	Remove P119 connector from generator. Check P119 and J119 connectors for damage, arcing, or contamination.	a. No contamination present.	a. Clean with approved alcohol or freon degreaser.
		b. No damage present.	b. Replace generator stator or ignition cable as required.
6.	Connect PWA 62502-1 adapter cable to PWA 52169 test lead cable.		
7.	Connect PWA 52169 cable (with adapter) to P119 on ignition cable and to J3 connector on ISTS.		

Table 3. Augmentor Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication

CAUTION

Do not operate generator simulator output for extended periods because internal simulators are subject to full current. When operating augmentor circuit, do not exceed duty cycle of 24 seconds maximum ON, 25 miutes minimum OFF. When operating gas generator circuit, do not exceed 5 minutes ON, 5 minutes minimum OFF. If these duty cycles are exceeded, engine exciter will be damaged and test set may shut down due to overheating.

NOTE

Interlock switch shall be activated anytime generator simulator is to supply power to ignition system. PWA 52185A interlock cap may be used in place of PWA 52234 high tension lead.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
A. 8.	Connect PWA 52234 cable to J2 connector on ISTS. Do not connect other end of cable.	Interlock switch is down (activated).	Further engage PWA 52234 cable or install PWA 52185A interlock cap.
9.	Remove P104 connector from AFC. Connect PWA 62502-5 cap assembly to J104 connector. See figure 12.		
10.	Position output PWR switch to ON.		
11.	Position EXC SEL switch to B-L.H. AUG.		
12.	Rotate VOLTS ADJ knob clockwise to obtain 200 RMS volts.	a. RMS VOLTS indicator displays 200 RMS volts.	a. Adjust knob as required to obtain 200 volts.
		b. Igniter does not spark.	b. Replace AFC ignition switch module.
		c. Igniter begins to spark at MIN AUG.	c.1. Check throttle rigging.
			c.2. If within limits, replace AFC ignition switch module.

Table 3. Augmentor Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
A. 13.	Observe LH igniter sparking for approximately 10 seconds. Check for proper arcing path and color. See figure 10.	Igniter sparks properly.	Perform check on RH igniter. Go to step 14.
14.	Rotate VOLTS ADJ knob to full counterclockwise position.	RMS VOLTS indicator displays 0 volts.	Repair/replace ISTS.
15.	Position EXC SEL switch to C-R.H. AUG. position.		
16.	Rotate VOLTS ADJ knob clockwise to obtain 200 RMS volts.	a. RMS VOLTS displays 200 volts.	a.1. Adjust knob as required to obtain 200 volts. a.2. Replace AFC ignition switch module.
17.	Observe RH igniter sparking for approximately 10 seconds. Check for proper arcing path and color. See figure 10.	Igniter sparks properly.	Go to step 22.
18.	Rotate VOLTS ADJ knob to full counterclockwise position.	RMS VOLTS indicator displays 0 volts.	Repair/replace ISTS.
19.	If either LH or RH igniter fails static test, perform step B - EXCITER STATIC TEST.		
20.	If both igniters pass static test, go to step 21.		
21.	Perform electrical continuity check on ignition cable augmentor circuits. • P119 to P104 • P119 to P26L • P119 to P26R	a. Resistance checks all less than 5 OHMS.	a.1. Replace ignition cable. a.2. Replace generator stator.

Table 4. Augmentor Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
B.	EXCITER STATIC CHECK - Step A Unsuccessful.		
1.	Disconnect P30 from LH augmentor igniter.		

WARNING

- Ignition exciter voltage is deadly. Exciter shall be completely discharged before performing maintenance.
- Ground output lead of PWA 52176 grounding cable to unpainted screw head or to exciter mount bracket on engine.

CAUTION

- Do not discharge exciter by sparking to ground. Internal damage to exciter may occur unless initial discharge is through resistor.
- Coiling high tension lead into less than a 10-inch circle can cause cable damage.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
2.	Use PWA 52176 grounding cable to discharge LH exciter. Use resistor lead first; then use ground lead for one minute each.		
3.	Connect PWA 52234 cable to P30 on LH exciter-to-igniter cable and to J2 on ISTS.		
4.	Turn spark counter meter MTR PWR switch to ON.		
5.	Ensure MAN/AUTO switch is in MAN position.		
6.	Depress and release RESET button.	Spark counter displays 0.	
7.	Position stored energy MTR PWR switch to ON position.		

Table 3. Augmentor Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
B. 8.	Position CAL ON switch to ON position.	Stored energy meter displays 60 joules.	Adjust CAL ADJ knob to obtain a display value of 60 joules.
9.	Position CAL ON switch to OFF position.	Stored energy meter displays 0 joules.	
10.	Position EXC SEL switch to B-L.H. AUG position.		

CAUTION

- Do not discharge exciter by sparking to ground. Internal damage to exciter may occur unless initial discharge is through resistor.
- Coiling high tension lead into less than a 10-inch circle can cause cable damage.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
11.	Rotate VOLTS ADJ knob clockwise to obtain 200 RMS volts.	a. RMS VOLTS indicator displays 200 volts.	a. Adjust knob as required to obtain 200 volts.
		b. Stored energy meter value 50 to 63 joules.	b.1. Check exciter-to-igniter cable continuity.
			b.2. If resistance is within limits, replace LH exciter.
			b.3. If resistance is out of limits, replace exciter to igniter cable.
			c. Repeat test.

Table 3. Augmentor Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
B. 12.	Press and release START button. Repeat for one second cycle.	a. After 10 seconds, spark counter displays 120 to 180.	a.1. Check exciter-to-igniter cable continuity. a.2. If resistance is within limits (LT 500 OHMS), replace LH exciter. a.3. If resistance is out of limits, replace exciter to igniter cable. b. Go to step 18.
13.	Rotate VOLTS ADJ knob to full counterclockwise position.	RMS VOLTS indicator displays 0 volts.	Repair/replace ISTS.
14.	Disconnect PWA 52234 cable from P30 connector on exciter-to-igniter cable.		

Table 3. Augmentor Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication

WARNING

- Ignition exciter voltage is deadly. Exciter shall be completely discharged before performing maintenance.
- Ground output lead of PWA 52176 grounding cable to unpainted screw head or to exciter mount bracket on engine.

CAUTION

- Do not discharge exciter by sparking to ground. Internal damage to exciter may occur unless initial discharge is through resistor.
- Coiling high tension lead into less than a 10-inch circle can cause cable damage.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
B. 15.	Use PWA 52176 grounding cable to discharge RH exciter. Use resistor lead first; then use ground lead for one minute each.		
16.	Reconnect P30 connector to LH augmentor igniter. Ensure plastic protective cover is installed.		
17.	Disconnect P30 connector from RH augmentor igniter.		

Table 3. Augmentor Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication

WARNING

- Ignition exciter voltage is deadly. Exciter shall be completely discharged before performing maintenance.
- Ground output lead of PWA 52176 grounding cable to unpainted screw head or to exciter mount bracket on engine.

CAUTION

- Do not discharge exciter by sparking to ground. Internal damage to exciter may occur unless initial discharge is through resistor.
- Coiling high tension lead into less than a 10-inch circle can cause cable damage.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
B. 18.	Use PWA 52176 grounding cable to discharge RH exciter. Use resistor lead first; then use ground lead for one minute each.		
19.	Connect PWA 52234 cable to P30 connector on RH exciter-to-igniter cable.		
20.	Depress and release RESET button.	Spark counter displays 0.	
21.	Position EXC SEL switch to D-R.H. AUG.		

Table 3. Augmentor Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication

CAUTION

- Do not discharge exciter by sparking to ground. Internal damage to exciter may occur unless initial discharge is through resistor.
- Coiling high tension lead into less than a 10-inch circle can cause cable damage.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
B. 22.	Rotate VOLTS ADJ knob clockwise to obtain 200 RMS volts.	a. RMS VOLTS indicator displays 200 volts.	a. Adjust knob as required to obtain 200 volts.
		b. Stored energy meter value 39 to 53 joules.	b.1. Check exciter-to-igniter cable continuity.
			b.2. If resistance is within limits, replace RH exciter.
			b.3. If resistance is out of limits, replace exciter-to-igniter cable.
			c. Repeat test.
23.	Depress and release START button. Repeat for a second cycle.	a. After 10 seconds spark counter displays 10 to 50.	a.1. Check exciter-to-igniter cable continuity.
			a.2. If resistance is within limits (LT 50 OHMS), replace RH exciter.
			a.3. If resistance is out of limits, replace exciter-to-igniter cable.
			b. Repeat test.
24.	Rotate VOLTS ADJ knob to full counterclockwise position.	RMS VOLTS indicator displays 0 volts.	Repair/replace ISTS.

Table 3. Augmentor Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
B. 25.	Disconnect PWA 52234 cable from P30 connector on RH exciter-to-igniter cable.		

WARNING

- Ignition exciter voltage is deadly. Exciter shall be completely discharged before performing maintenance.
- Ground output lead of PWA 52176 grounding cable to unpainted screw head or to exciter mount bracket on engine.

CAUTION

- Do not discharge exciter by sparking to ground. Internal damage to exciter may occur unless initial discharge is through resistor.
- Coiling high tension lead into less than a 10-inch circle can cause cable damage.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
26.	Use PWA 52176 grounding cable to discharge RH exciter. Use resistor lead first; then use ground lead for one minute each.		
27.	Reconnect P30 to RH exciter.		
28.	Remove PWA 56071 plastic protective covers from igniters.		
29.	Reinstall LH and RH augmentor igniters.		
30.	Remove cap assembly, PWA 62502-5, from J104 connector. Reconnect P104 to J104.		

Table 3. Augmentor Ignition System Analysis (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
C.	POSTTEST PROCEDURE.		
1.	Turn all POWER switches OFF.		
2.	Disconnect PWA 52234 cable from J2 on ISTS. Stow cable.		
3.	Disconnect PWA 52166 cable from power source and J1 on ISTS. Stow cable.		
4.	Stow plastic protective covers and open circuit connector.		
5.	Reinstall lid on ISTS.		

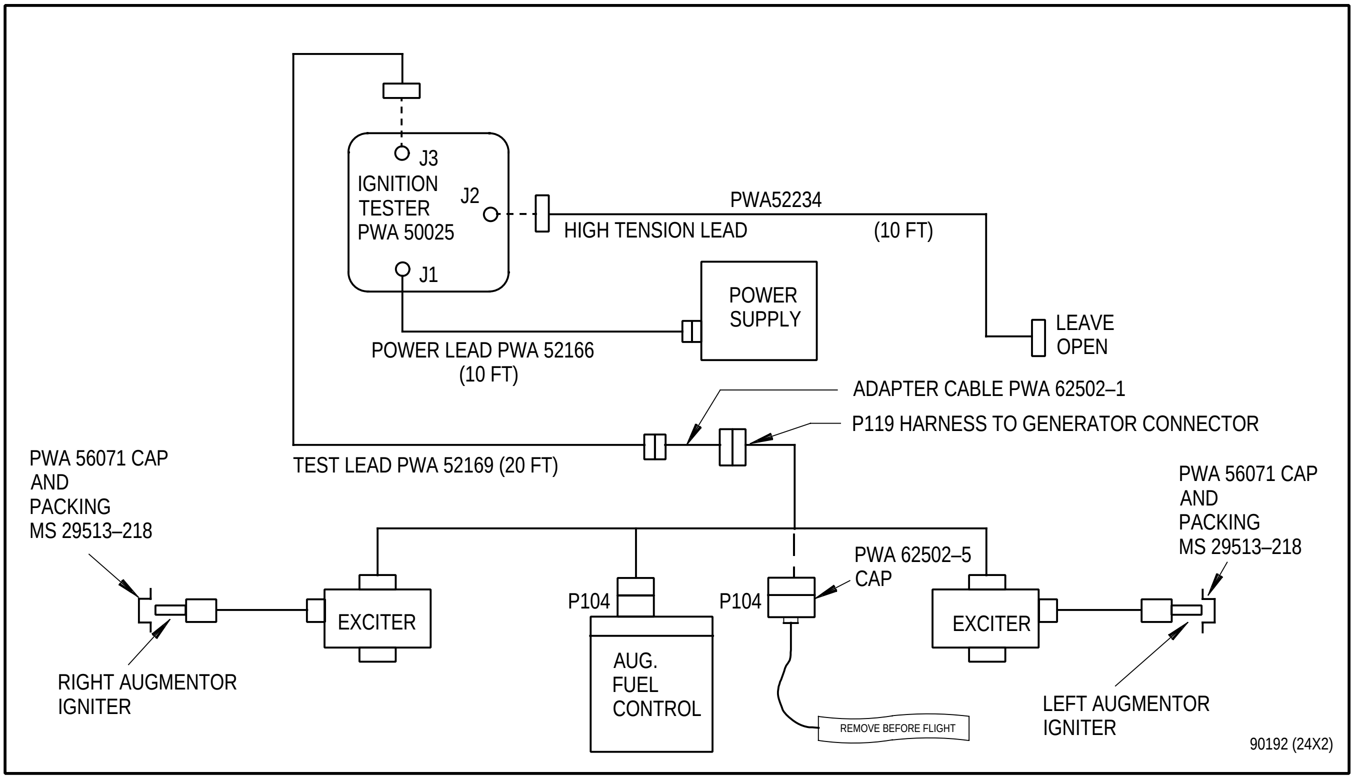


Figure 10. Augmentor Ignition System - Static Check Procedure

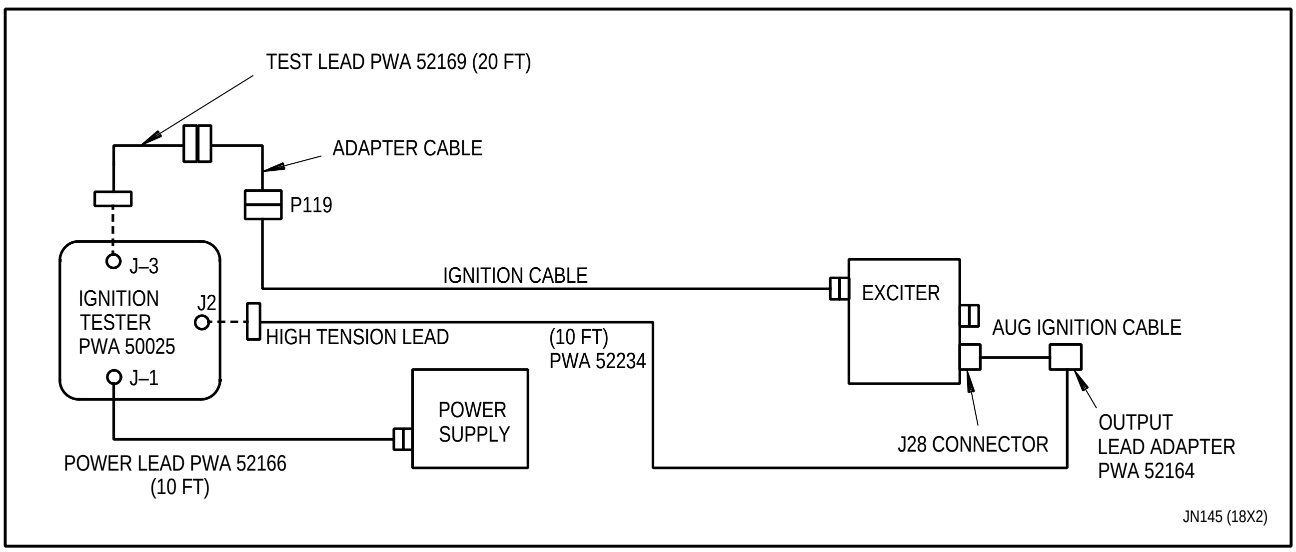


Figure 11. Augmentor - Static Exciter Test

6. IGNITION SYSTEM ANALYSIS USING PN 137375 IGNITION SYSTEM TESTER. (See Figure 12 and Table 4.)

WARNING

- Avoid contact with ignition exciter and associated output leads/plugs while ignition system is energized. High voltage ignition system can cause shocks, burns, and death.
- If test set ignition firing indicator does not flash, do not assume high voltage is not present at exciter output. High voltage ignition system can cause shocks, burns, and death.

NOTE

Poor output lead connections could result in erratic operation of ignition system tester. Exciters shall be properly connected, all output leads shall be in good condition and properly torqued.

a. Perform main and/or augmentor ignition system analysis per table 4.

Table 4. Ignition System Analysis Using PN 137375 Tester

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
A.	**FIRING LEFT AND RIGHT MAIN AND AUGMENTOR IGNITERS USING HARNESSES AND EXCITER.**		
1.	Remove left and right main igniters and/or augmentor igniters from engine.		
2.	Inspect igniters.	Igniters within limits.	Replace igniter.
3.	Reconnect all igniters to ignition leads.		
4.	Install PN 137375-109 or PWA 52174 protective caps with correct packings on both main igniters and/or PN 137375-0110 or PWA 56071 protective caps with correct packings on both augmentor igniters.		
5.	Remove P119 connector from generator. Inspect P119 and J119 connectors for damage, arcing, or contamination.	a. No contamination present. b. No damage present.	a. Clean with approved solvents. b. Replace stator generator or ignition cable as required.

Table 4. Ignition System Analysis Using PN 137375 Tester (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
A.	(continued)		
6.	Connect PN 137375-0104 test lead to J3 on ignition tester and to PN 137375-0136 test adapter per figure 12.		
7.	Connect PN 137375-0136 test adapter to P119 connector.		
8.	Disconnect P113 from MFC and/or P104 from AFC. Inspect P113, J113, and/or P104 and J104 connectors for damage, arcing, and contamination.	a. No contamination present. b. No damage present.	a. Clean with approved solvents. b. Replace cable or control as necessary.
9.	Turn ignition test on by placing S1 to ON position.	AC light illuminates.	Troubleshoot tester.

NOTE

- Refer to steps A.10 through 13 for main exciters.
- Refer to steps A.14 through 17 for augmentor exciters.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
10.	Set S2 switch to IGNITION A position for left main igniter and press S6 ENTER to accept.		

CAUTION

Changing position of S2 switch while operating S3, with ignition firing, could result in damage to ignition system and ignition system tester.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
11.	Press and hold S3 to fire and test igniter. Release S3.	A clean, blue spark is visible at igniter tip. Sparking stops.	(1) Remove and replace non-sparking igniter. (2) Repeat this step. (3) If igniter replacement does not correct problem, troubleshoot per step B.

Table 4. Ignition System Analysis Using PN 137375 Tester (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
A.	(continued)		
12.	Set S2 switch to IGNITION C position for right main igniter and press S6 ENTER to accept.		

CAUTION

Changing position of S2 switch while operating S3, with ignition firing, could result in damage to ignition system and ignition system tester.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
13.	Press and hold S3 to fire and test igniter. Release S3.	A clean, blue spark is visible at igniter tip. Sparking stops.	(1) Remove and replace non-sparking igniter. (2) Repeat this step. (3) If igniter replacement does not correct problem, troubleshoot per step B.
14.	Set S2 switch to IGNITION B position for left augmentor igniter and press S6 ENTER to accept.		
15.	Press and hold S3 to fire and test igniter. Release S3.	A clean, blue spark is visible at igniter tip. Sparking stops.	(1) Remove and replace non-sparking igniter. (2) Repeat this step. (3) If igniter replacement does not correct problem, troubleshoot per step B.
16.	Set S2 switch to IGNITION D position for right augmentor igniter and press S6 ENTER to accept.		
17.	Press and hold S3 to fire and test igniter. Release S3.	A clean, blue spark is visible at igniter tip. Sparking stops.	(1) Remove and replace non-sparking igniter. (2) Repeat this step. (3) If igniter replacement does not correct problem, troubleshoot per step B.

Table 4. Ignition System Analysis Using PN 137375 Tester (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
B.	(continued)		
18.	Turn ignition test off by placing S1 to OFF position.	AC light goes out.	Troubleshoot test set.
19.	Remove protective caps and install igniters into engine. Reconnect P113 to J113, P104 to J104, and P119 to J119.		
B.	**EXCITER OUTPUT CHECKS WITH HARNESSES INSTALLED.**		
1.	If not previously accomplished, disconnect P113 connector from MFC and/ or P104 connector from AFC, and P119 from generator. Inspect P113, J113, P104, J104, P119 and J119 for damage, arcing, and contamination.	a. No contamination present. b. No damage present.	a. Clean with approved solvents. b. Replace MFC, AFC, generator, or cable as required.
2.	If not previously accomplished, connect test lead PN 137375-0104 between ignition system tester and test adapter PN 137375-0136 per figure 12. Connect test adapter PN 137375-0136 to cable connector P119.		

NOTE

- Refer to steps B.3 through 12 for main exciters.
- Refer to steps B.13 through 22 for augmentor exciters.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
3.	Connect discharge sensor PN 137375-0111 to left main ignition lead. Connect sensor input lead PN 137375-0103 to discharge sensor PN 137375-0111 and to ignition tester J4 connection.		
4.	Turn ignition set on by placing S1 to ON position.	AC light illuminates.	Troubleshoot tester.

Table 4. Ignition System Analysis Using PN 137375 Tester (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
B.	(continued)		
5.	Set S2 to IGNITION A and scroll using S4 and S5 to TEST #4. Press S6 ENTER to accept.		
6.	Press and hold S3 to fire and test ignition. Hold down S3 until a reading appears on main display. Compare results to test limits.	IGNITION FIRING indicator flashes. Display indicates "Taking readings". Results within limits of 1 to 5 sparks per second and 3.0 to 5.1 joules.	If left main igniter does not fire, replace high tension lead with test set PN 137375-0107 and repeat test using TEST #3. If igniter now fires, old ignition lead is bad and should be replaced. If igniter still does not fire, install old ignition old ignition lead and continue test.
7.	Turn ignition test set off by placing S1 to OFF position.	AC light goes out.	Troubleshoot test set.
8.	Disconnect discharge sensor PN 137375-0111 from left main ignition lead and connect to right main ignition lead.		
9.	Turn ignition test set on by placing S1 to ON position.	AC light illuminates.	Troubleshoot test set.
10.	Set S2 to IGNITION C and scroll using S4 and S5 to TEST #4. Press S6 ENTER to accept.		

Table 4. Ignition System Analysis Using PN 137375 Tester (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
B.	(continued)		
11.	Press and hold S3 to fire and test ignition system. Hold down S3 until a reading appears on main display. Compare results with test limits.	IGNITION FIRING indicator flashes. Display indicates "Taking readings". Results within limits of 1 to 5 sparks per second and 3.0 to 5.1 joules. Results with limits.	If right main igniter does not fire, replace high tension lead with PN 137375-0107 test lead and repeat test using TEST #3. If igniter now fires, high tension lead is bad and should be replaced. If igniter still does not fire, install old lead and continue test.
12.	Turn tester off by placing S1 to OFF position.	AC light goes out.	Troubleshoot test set.
13.	Disconnect discharge sensor PN 137375-0111 from right main ignition lead and connect to left augmentor lead.		
14.	Turn ignition test set on by placing S1 to ON position.	AC light illuminates.	Troubleshoot test set.
15.	Set S2 to IGNITION B and scroll using S4 and S5 to TEST #6. Press S6 ENTER to accept.		

Table 4. Ignition System Analysis Using PN 137375 Tester (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
B.	(continued)		
16.	Press and hold S3 to fire and test ignition system. Hold down S3 until a reading appears on main display. Compare results with test limits.	IGNITION FIRING indicator flashes. Display indicates "Taking readings". Results within limits of 11.2 to 17.0 sparks per second and 2.1 to 3.1 joules.	If left augmentor igniter does not fire, replace high tension lead with test set PN 137375-0-0108 test lead. Repeat test using TEST #5. If left augmentor igniter now fires, high tension lead is bad and should be replaced. If igniter still does not fire, install old lead and continue test.
17.	Turn test set off by placing S1 to OFF position.	AC light goes out.	Troubleshoot test set.
18.	Disconnect discharge sensor PN 137375-0111 from left augmentor lead and connect to right augmentor lead.		
19.	Turn ignition test set on by placing S1 to ON position.	AC light illuminates.	Troubleshoot test set.
20.	Set S2 to IGNITION D and scroll using S4 and S5 to TEST #6. Press S6 ENTER to accept.		

Table 4. Ignition System Analysis Using PN 137375 Tester (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
B.	(continued)		
21.	Press and hold S3 to fire and test ignition system. Hold down S3 until a reading appears on main display. Compare results with test limits.	IGNITION FIRING indicator flashes. Display indicates "Taking readings". Results within limits of 11.2 to 17.0 sparks per second and 2.1 to 3.1 joules. Results with limits.	If right augmentor igniter does not fire, replace high tension lead with PN 137375-0-0108 test lead and repeat test using TEST #5. If right augmentor igniter now fires, high tension lead is bad and should be replaced. If igniter still does not fire, install old lead and continue test.
22.	Turn ignition test set off by placing S1 to OFF position.	AC light goes out.	Troubleshoot test set.
23.	If all readings are within limits, disconnect PN 137375-0111 Discharge Sensor and PN 137375-0103 test lead from right augmentor high tension lead and reconnect all high tension leads to respective igniters. If any readings are out of limits, replace appropriate exciter and repeat steps for section A to verify all igniters fire. If an igniter still does not fire, replace respective igniter and repeat applicable step for section A. If igniter under test still does not fire, replace ignition lead and retest. After replacement of exciter igniter and ignition lead, if igniter still does not fire, replace power and speed harness and retest system starting at step A.1.	All readings within limits.	Replace suspect component and retest per respective step.

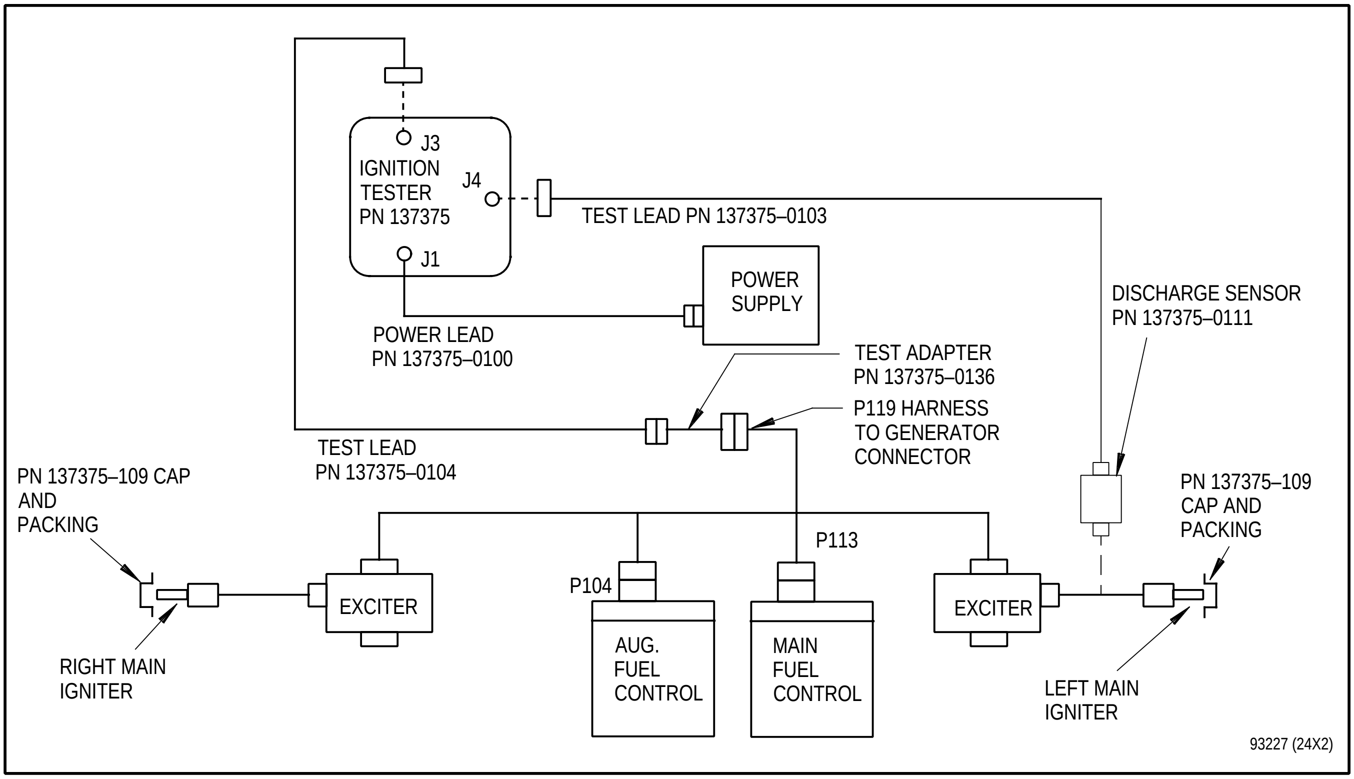


Figure 12. Ignition System Test - Using PN 137375 Tester

WORK PACKAGE

TECHNICAL PROCEDURES

ELECTRICAL CABLE CHECKS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 12	0				

REFERENCE MATERIAL REQUIRED

None

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Electrical Cable Checks	
	Ohmmeter -	PSM-6 or equivalent

ILLUSTRATED SUPPORT EQUIPMENT

None

1. INTRODUCTION.

a. This work package provides schematics for performing electrical continuity checks in cables which have been previously rejected or suspect.

2. ELECTRICAL CABLE CHECKS.
(See Figures 1 through 10.)

a. Prior to rejecting cables, perform continuity checks on circuits that are out of limits. All continuity checks should be less than 5 ohms except FTIT and Tt2 circuits which should be less than 10 ohms. (See figures 1 through 10.)

b. If electrical cable continuity is within limits, loose or contaminated connectors, or connectors with damaged pins should be suspect. Tighten, clean or straighten connectors and pins as required.

c. In the event that electrical connector pin or socket identification labels have worn off, see figure 1 for identification.

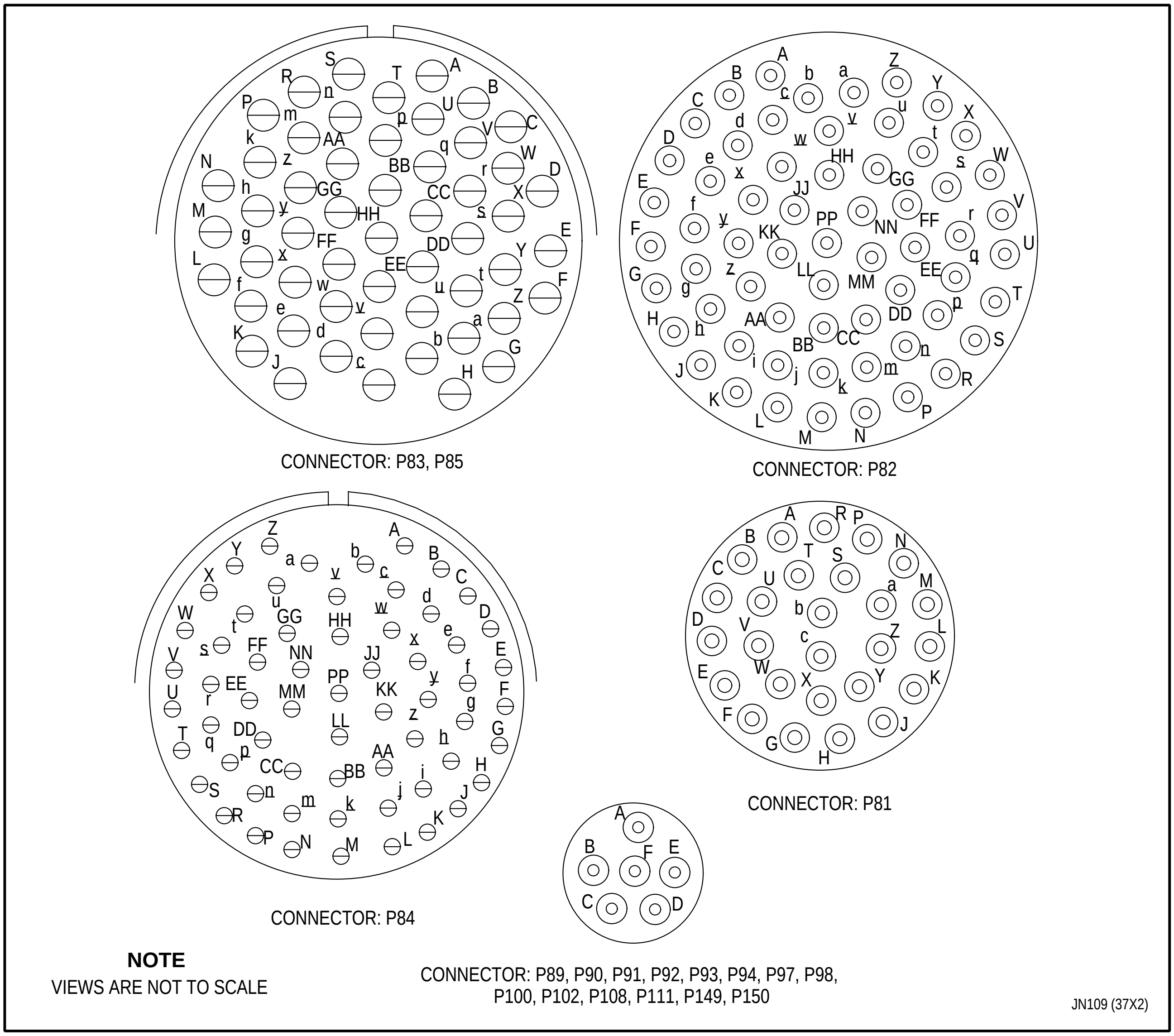


Figure 1. Electrical Connector Pin or Socket Identification (Sheet 1 of 2)

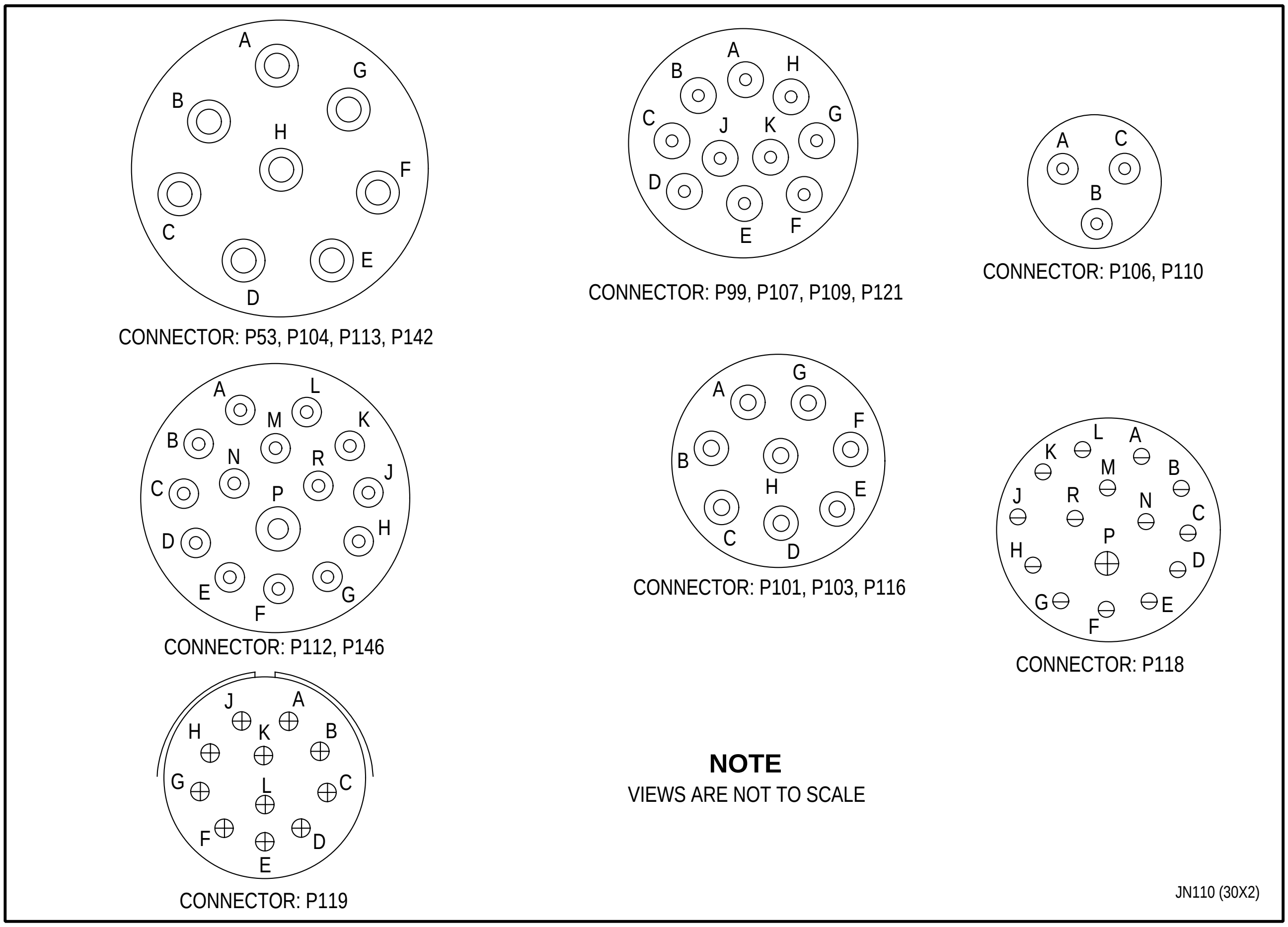


Figure 1. Electrical Connector Pin or Socket Identification (Sheet 2 of 2)

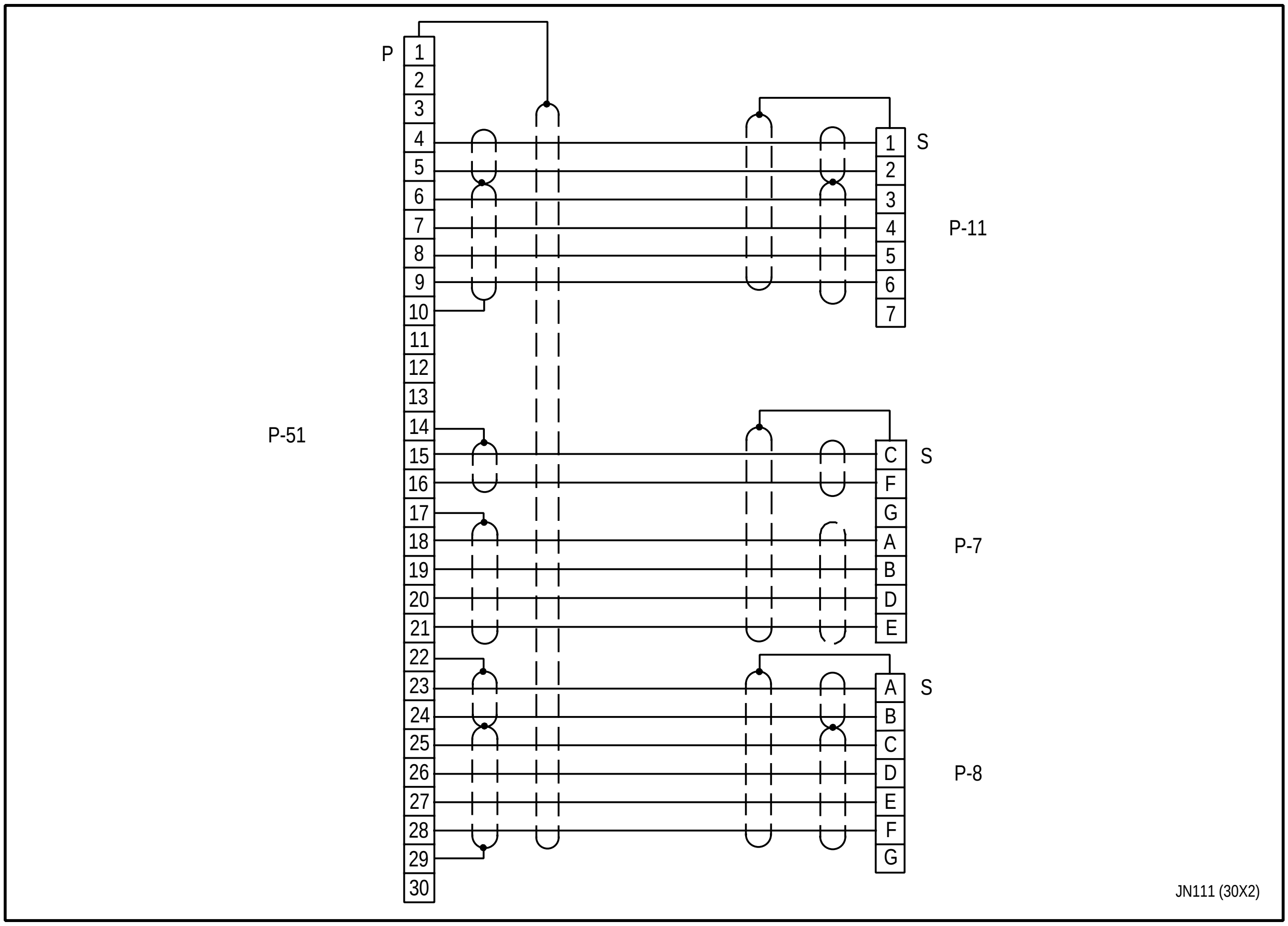


Figure 2. Accessories Cable Wiring Schematic

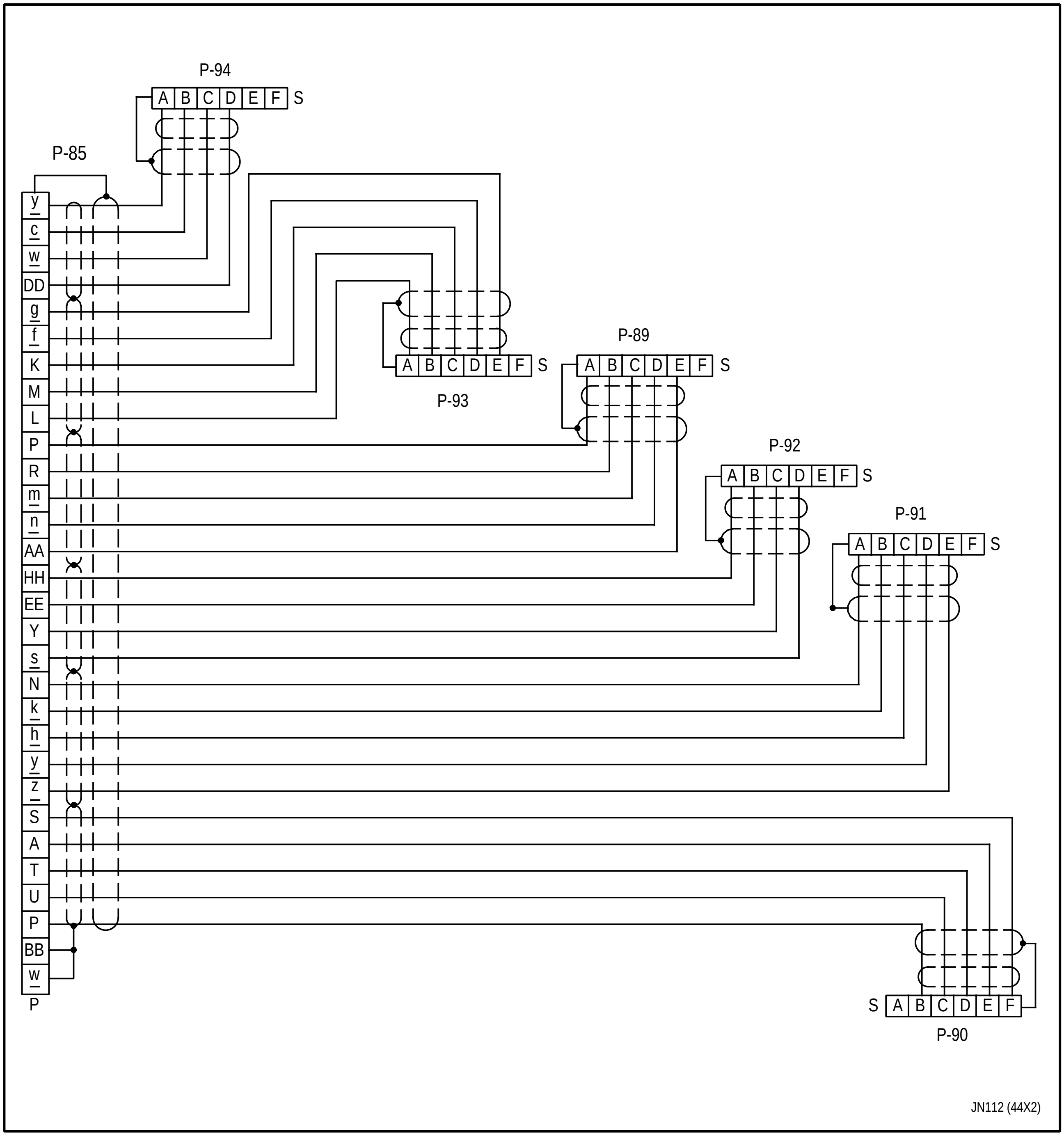


Figure 3. Actuator Cable Wiring Schematic

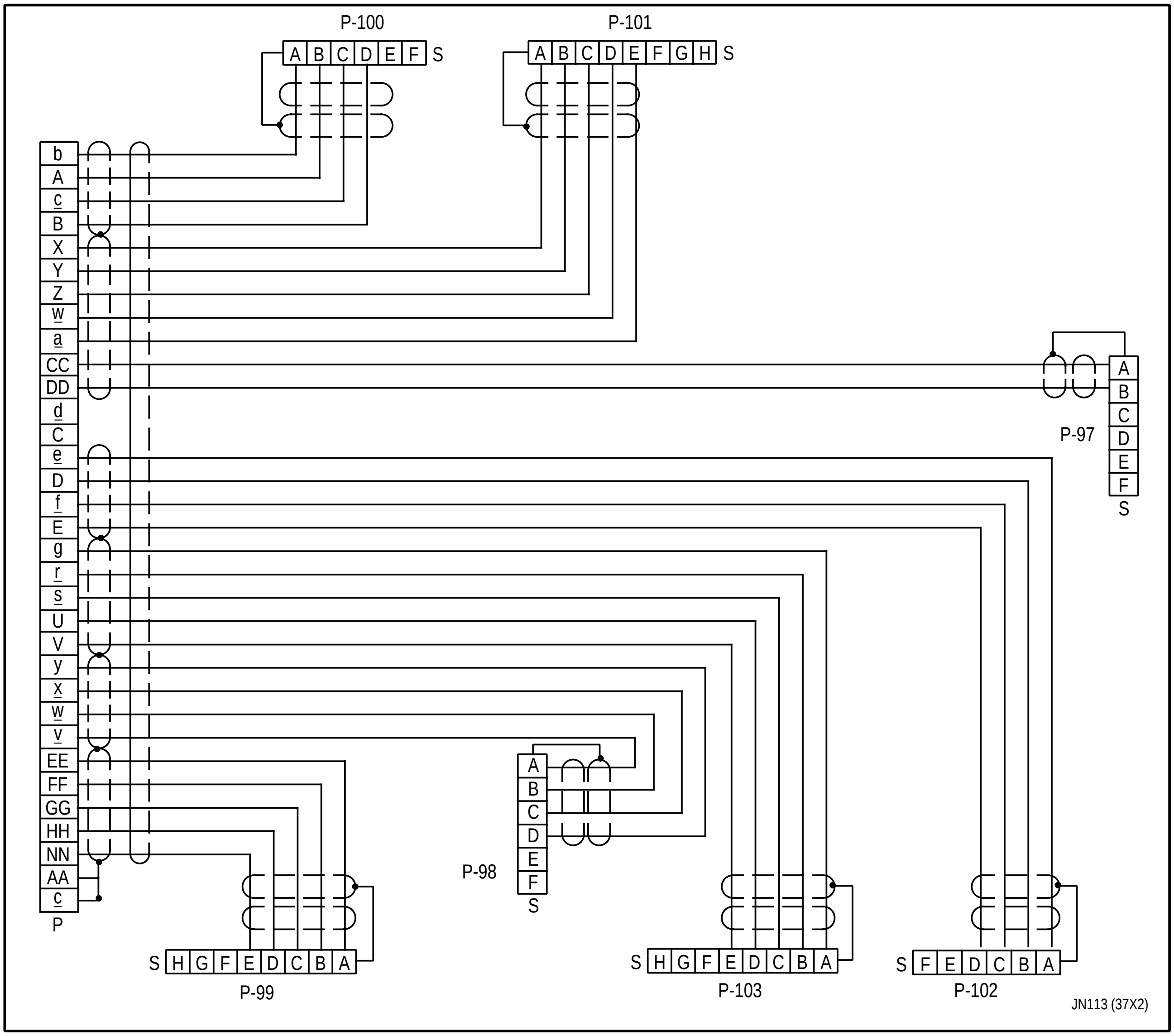


Figure 4. Augmentor Control Cable Wiring Schematic

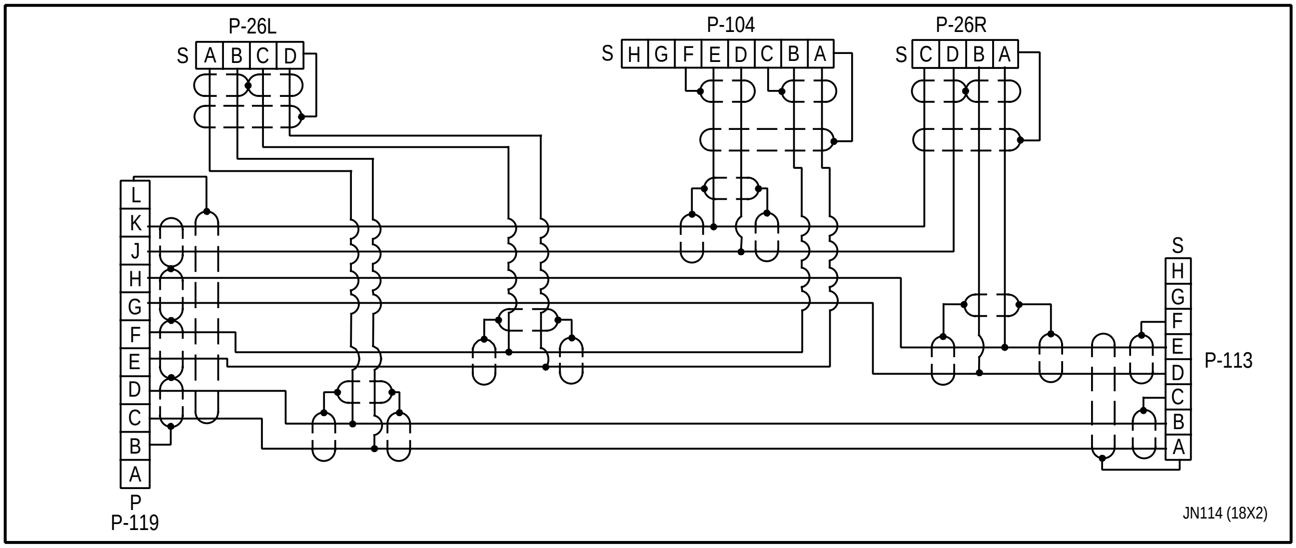


Figure 5. Ignition Cable Wiring Schematic

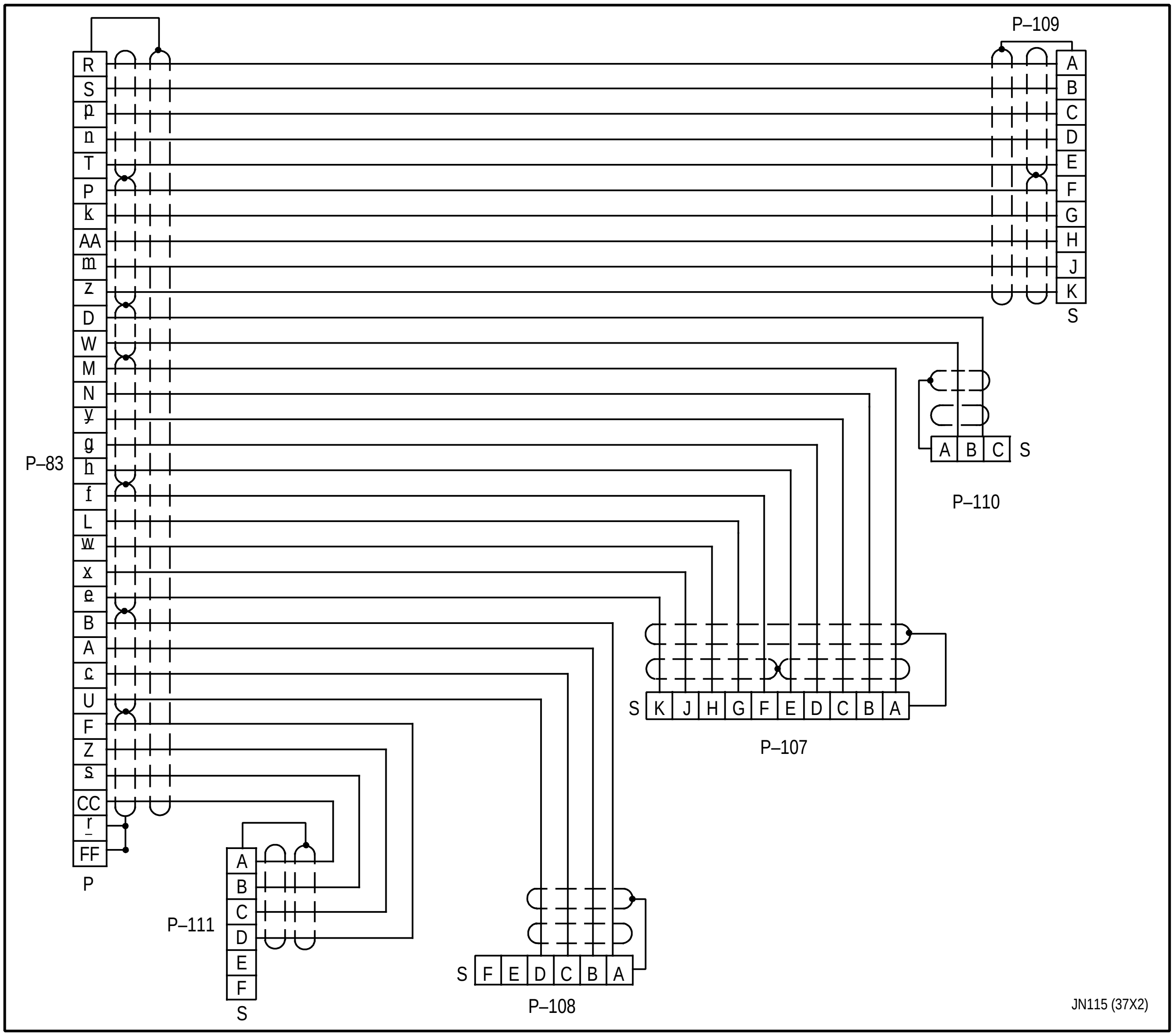


Figure 6. Main Fuel Control Cable Wiring Schematic

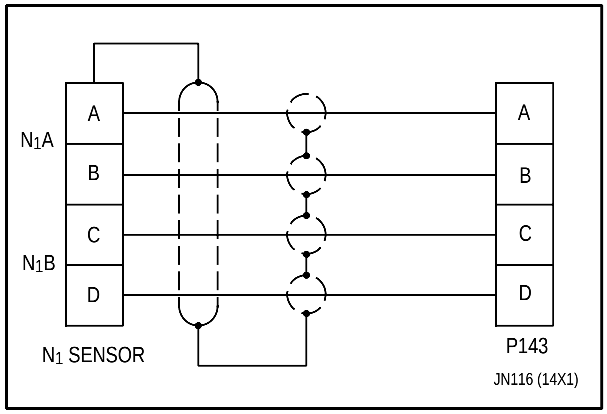


Figure 7. N1 Sensor Inlet Case Cable Wiring Schematic

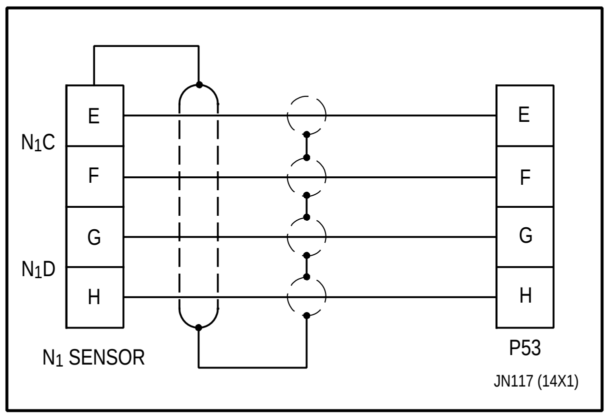


Figure 8. N1 Sensor Inlet Case Cable Wiring Schematic

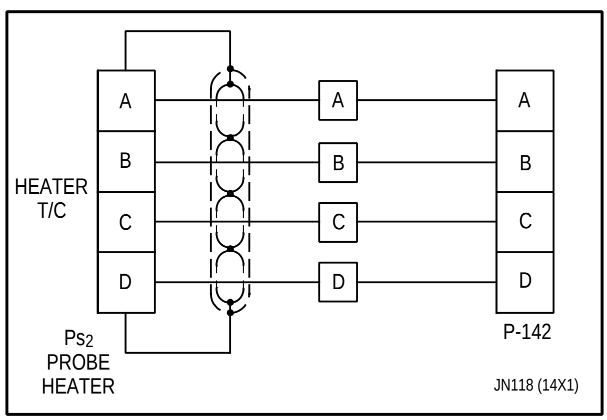


Figure 9. Ps2 Probe Inlet Case Cable Wiring Schematic

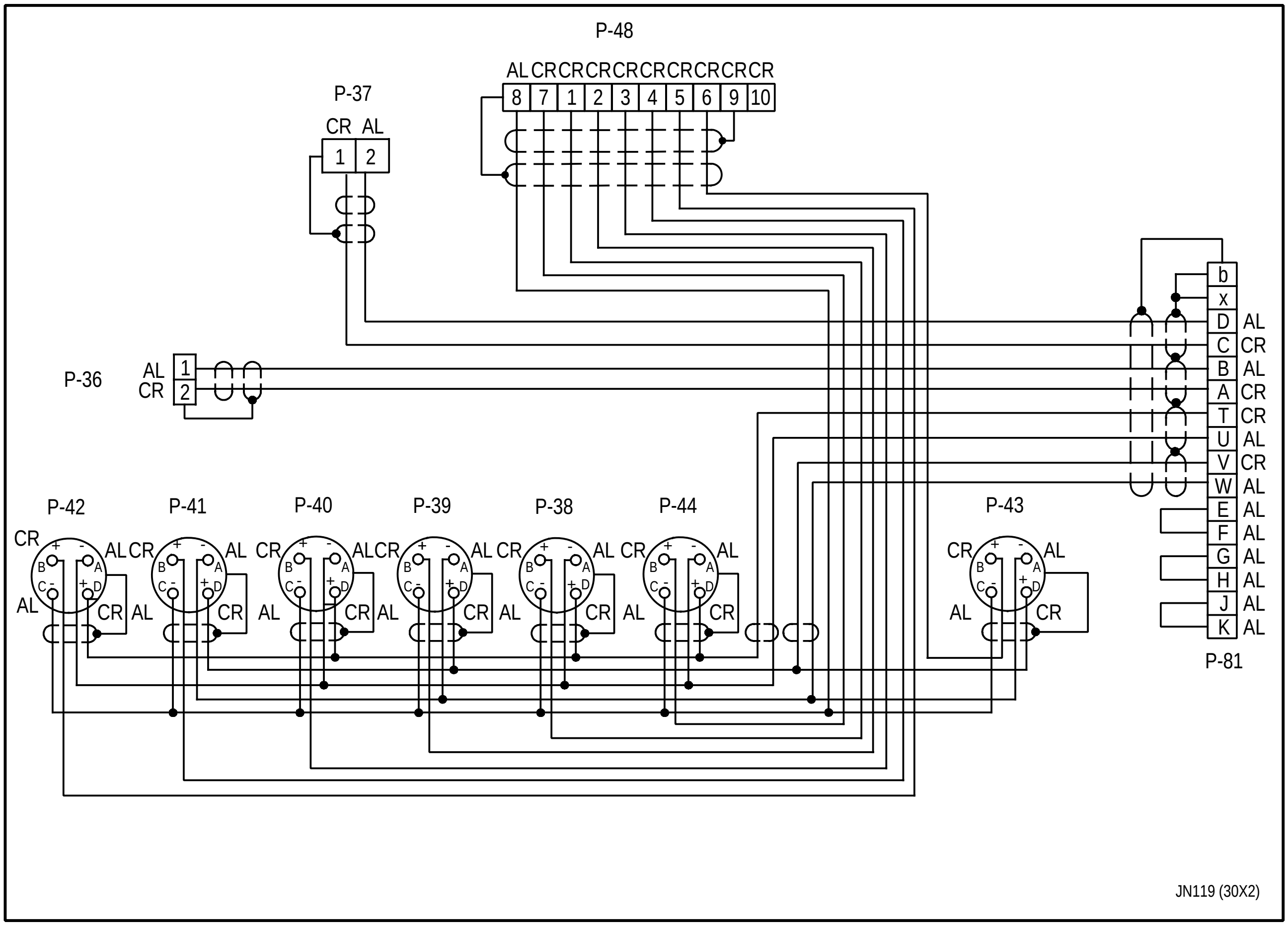


Figure 10. Temperature Cable Wiring Schematic

WORK PACKAGE

TECHNICAL PROCEDURES

COMPRESSOR BLEED SYSTEM FUNCTIONAL CHECK

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 6

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test ------------------------------	T.O. 2J-F100-11-2
Engine Troubleshooting - General ----------------	WP 501 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

None

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	COMPRESSOR BLEED SYSTEM FUNCTIONAL CHECKC	
	OHMMETER ----------------------------	PSM-6 OR EQUIVALENT
	TESTER-BLEED ACTUATING, CYLINDER CHECK --------	PWA 57448 OR
	PUMP, FUEL --------------------------	PWA 51409

ILLUSTRATED SUPPORT EQUIPMENT

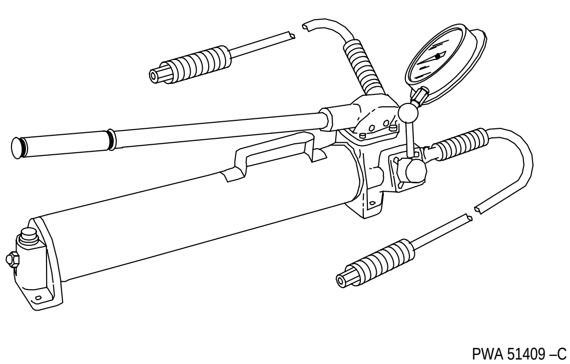


Figure T1. PWA 51409 PUMP

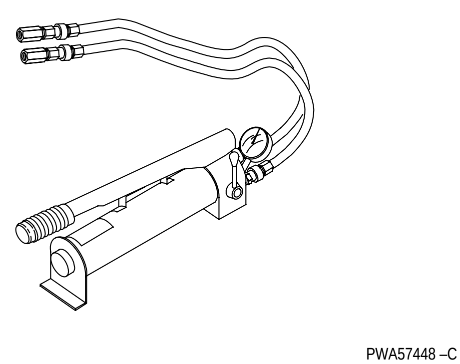


Figure T2. PWA 57448 TESTER

1. INTRODUCTION.

a. This work package contains troubleshooting procedure for compressor bleed system functional check.

2. COMPRESSOR BLEED SYSTEM FUNCTIONAL CHECK.

(See Figure 1 and Table 1.)

a. Perform resistance checks and corrective actions per table 1.

CAUTION

Only MIL-T-5624 engine fuel or MIL-L-6081 lubricating oil shall be used in PWA 57448 tester. Use of any other fluid could result in engine contamination and damage.

b. Disconnect coupling nuts securing Pfsbo tube and Pfsbc tube. Discard gaskets.

c. Connect hoses from PWA 57448 tester to Pfsbo and Pfsbc ports on compressor bleed linear actuating cylinder.

d. Set the tester selector valve to close off pressure to Pfsbo port.

e. Observe bleed valve and linkage through 7th stage bleed cover plate, using an inspection mirror with light or borescope through AP2.

f. Develop 200 psig tester pressure and check that linkage moves freely and bleed valve strap moves through full travel. Check for increased tension on strap when it closes. If there is no tension, strap has failed.

g. Release pressure and set the tester selector valve to close off pressure to Pfsbc port.

h. Develop 200 psig tester pressure and check that linkage moves freely and bleed valve strap moves through full travel.

i. If bleed valve functions properly, install PN ST2229-04 gaskets and reconnect tube nuts. Torque nuts 90 to 100 pound-inches.

j. If linkage binds or does not move freely, accomplish the following:

(1) Remove compressor bleed valve linear actuating cylinder. Ensure cylinder operates freely in both directions.

(2) If linear actuating cylinder moves freely, disassemble engine to gain access to the bleed valve linkage. Replace linkage as required.

Table 1. Compressor Bleed System - Resistance Check

Step	Procedure	Result	Corrective Action
1.	Check compressor bleed solenoid circuit. Perform the following resistance checks:		
	CONN P83 PINS	a. Resistance checks out of limits:	a. Go to step 2.
	1. W to D 2. D to GND	1. 90 to 160 OHMS 2. GT 100,000 OHMS	
		b. Resistance checks within limits.	b. Discontinue resistance checks. Continue with system analysis.
2.	CONN J110 PINS	a. Resistance checks out of limits.	a. Replace MFC start bleed solenoid.
	1. A to B 2. B to GND	1. 90 to 160 OHMS 2. GT 100,000 OHMS	
		b. Resistance checks within limits.	b. Replace MFC cable.

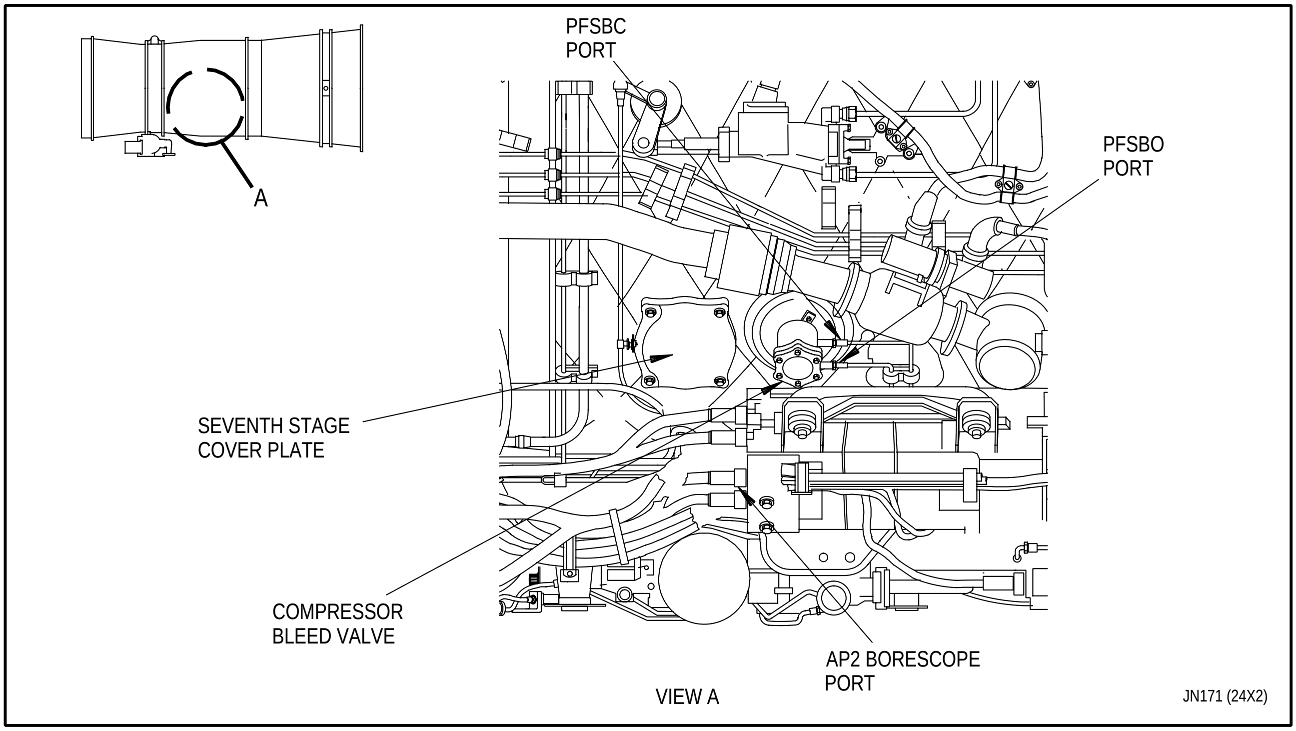


Figure 1. Compressor Bleed Cylinder Functional Check

WORK PACKAGE

TECHNICAL PROCEDURES

ENGINE, INTERNAL AND EXTERNAL -

CLEANING

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 12

PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
1 - 12	0				

REFERENCE MATERIAL REQUIRED

Title	Number
Cleaning of Aerospace Equipment	T.O. 1-1-1
Standard Maintenance Procedures	T.O. 2-1-111
Engine Test	T.O. 2J-F100-11-2
Engine Prestart Procedures	WP 207 00
Engine Testing Requirements	WP 206 00
Acceleration/Deceleration Check Procedures	WP 213 00
Engine Troubleshooting - General	WP 501 00
Engine Accessories and Rigging Procedures	T.O. 2J-F100-53-4
Control - Engine Digital Electronic	WP 007 00
Diagnostic Unit - Engine	WP 023 00
Engine	T.O. 2J-F100-53-5
Borescope Inspection	WP 020 00

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
Alcohol	O-E-760, Type 3
Cleaner, gaspath	B and B 3100 (FSN 6850-00-181-7597)
Degreaser, spray aerosol	Freon TF (2002)

EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

Paragraph	Function - Tool Nomenclature	Tool Number
2	Engine Cleaning, Internal and External	
	Cable assembly, control -----------	PN 103-3111-1
	Tester, hydraulic pressure ---------	PWA 50096
	Adapter, fan inlet case -----------	PWA 55157
	Bracket, fan inlet case -----------	PWA 55803

ILLUSTRATED SUPPORT EQUIPMENT

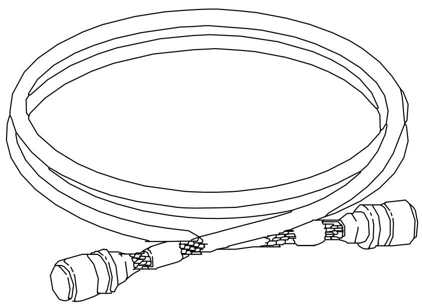

PN 10331111 –C

Figure T1. PN 103-3111-1 Control

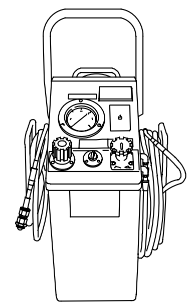

PWA 50096 –C

Figure T2. PWA 50096 Tester

1. INTRODUCTION.

a. This work package contains procedures for cleaning and removing contaminants from internal and some external engine areas.

2. ENGINE CLEANING, INTERNAL AND EXTERNAL.

(See Tables 1 through 5.)

NOTE

Engine cleaning is performed to remove unwanted internal contaminants from engine such as industrial pollutants, sea salt, oil, or grease deposits and fire extinguisher chemicals.

a. Determine maintenance to be performed per table 1.

b. Water wash requirements:

(1) Jet engine water wash consists of an application of cleaning solution while motoring engine on test stand.

(2) A soak period is followed by pure water rinse.

(3) The cleaning solution consists of 4 to 1 mixture of potable water (80%) and jet engine gaspath cleaner (20%).

(4) The only approved gaspath cleaner is B and B 3100 (FSN 6850-00-181-7597):

B and B Chemical Company
875 West 20th Street
Hialeah, Florida 33010

(5) The cleaning solution injected into engine shall not exceed flow rate of 2.5 gallons per minute (gpm); 9.5 liters per minute.

(6) The cleaning solution shall be injected into borescope ports fitted with adapters when injecting water into core module. The inlet spray nozzle shall have an orifice size of 0.113 inch. Proper solution flow distribution shall be 50% into the fan, 25% into AP 2 port, and 25% into AP 3 port with a solution pressure of 25 to 150 psig.

(7) Engine shall be capable of being run to Intermediate (MIL) following water wash to ensure all water is removed; failure to do so may cause engine damage. This need not apply for engines being sent to depot for chemical fire extinguisher removal.

(8) Ensure engine is shut down minimum of three hours before attempting to water wash; water washing hot engine will cause engine damage.

(9) Water used in both cleaning solution and for rinsing shall meet one of the following specifications:

(a) Section I, paragraph 1-141 of T.O. 2-1-111.

(b) Potable water per:

- EPA 40 CFR 144 Primary Drinking Water Standards or
- EPA 40 CFR 143 Secondary Drinking Water Standards

Table 1. Engine Cleaning Requirements

Step	Reason For Cleaning	Test/Procedure Requirements	T.O. Reference	Remarks
A.	Removal of internal deposits of industrial pollutants	1. Borescope or visually inspect engine to determine location of deposits.	1. T.O. 2J-F100-53-5, WP 020 00.	
		2. Internal water wash	2. Table 2	**NOTE** Engine inspections may be performed on a scheduled basis locally if required by environmental conditions. 2. Borescope or visually inspect engine after water wash(es) to determine if deposits have been removed. Repeat wash procedure until deposits are removed.
B.	Fire extinguisher chemical exposure	1. Refer to tables 4 and 5 for required procedures		1. Remove any components damaged due to heat or mechanical damage. Cap all exposed tubes.
		2. External wash procedure	2. Table 3	2. External deposits should be removed by hand washing if less than 10% of engine surface area has been exposed.
		3. Internal wash procedure	3. Table 2	
		4. Return engine to depot.		4. Engine requires complete teardown, cleaning, and inspection at depot. Note occurrence on engine and module AFTO 95 forms.

Table 2. Internal Wash Procedure

Step	Procedure	Normal Indication	Remedy For Abnormal Indication

CAUTION

- Engine shall be shut down for minimum of three hours before water wash.
- If ambient temperature of 32°F (0°C) or below, do not water wash.
- If engine cannot be run to Intermediate (MIL), do not water wash.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
1.	Mount engine on test cell rails. Do not use bellmouth inlet screen.		
2.	Connect test cell P1, P2, and P3 connectors of PN 103-3111-1 control to EDU at junctions J1, J2, and J3.		
3.	Prepare engine plumbing: (a) Remove Pb and Pt6 tubes from moisture traps. Disconnect moisture trap drain line. (b) Remove Pab line at front of AFC. Put temporary cap on AFC side. Cap Pb and Pt6. (c) Disconnect Ps2 tube at inlet fan case boss. Cap tube temporarily. (d) Remove both 13th stage compressor bleed covers. (e) Disconnect three SEC mode Ps2 tubes at inlet fan case bosses. Temporarily cap Ps2 tubes.		
4.	Using ignition lockout switch, deactivate left and right main and augmentor ignition circuits.		

Table 2. Internal Wash Procedure (continued)

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
5.	Install protective cap on Ps2 nose probe.		
6.	Use PWA 50096 tester to actuate RCVV cylinder to fully retracted (axial) position.		
7.	Provide starting capability to test cell.		
8.	Connect and rig power lever.		
9.	Make certain engine oil system is properly serviced.		

CAUTION

To prevent engine damage, ensure oil and fuel systems are intact before motoring engine. Repair as required.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
10.	Motor engine at 2100 to 2800 N2 rpm.		
11.	Provide water at inlet to engine. Do not exceed 20 gpm. Avoid high-velocity water directed at fan blades.		
12.	Spray engine for four minutes maximum.		
13.	Shut off water and allow engine spool-down.		
14.	Repeat procedure as necessary to remove internal deposits.		
15.	Activate main and augmentor ignition system.		
16.	Use PWA 50096 tester to actuate RCVV cylinder to fully extended (cambered) position.		

Table 2. Internal Wash Procedure (continued)

CAUTION

To prevent damage to engine controls, do not use compressed air greater than 60 psig.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
17.	Use compressed air at 40 to 60 psig to blow captured water from Pb, Pab, Pt6, and Ps2 lines.		
18.	If engine test run is required, begin engine preparation.		
19.	Connect Pb, Pab, Pt6, and 13th stage compressor bleed manifolds, Ps2 connections and OD1 drain tube.		
20.	If engine will be returned to depot, remove engine from test stand.		
21.	Install engine bellmouth screen.		
22.	Perform prestart inspections and adjustments.		

WARNING

To prevent engine damage, do not operate engine above IDLE prior to completing five minute warm-up period.

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
23.	Start engine. Run at IDLE for five minutes.	a. Engine starts satisfactorily.	a. Troubleshoot.
		b. No fuel leaks or air leaks at Pb, Pab, Pt6, or Ps2 (if required) fittings or compressor bleed manifolds previously disconnected.	b. Repair as required.
		c. Vibration within limits.	c. Discontinue testing immediately. Perform engine borescope inspection.
24.	Perform engine accel/ decel check.		
25.	Shut down engine.		

Table 3. Engine External Wash Procedure

Step	Procedure	Normal Indication	Remedy For Abnormal Indication
1.	Remove DEEC from engine.		
2.	Bag DEEC connectors to prevent contact with water spray.		
3.	Remove EDU from engine.		
4.	Bag EDU connectors to prevent contact with waterspray.		
5.	Cap fuel cooling lines to DEEC and EDU.		
6.	Make certain all ten borescope plugs are in place.		
7.	Spray water at locations which have contamination. Avoid directing high velocity water spray at components or augmentor nozzle hardware. As an alternate method, if removal of grease and dirt deposits (fuel, oil, etc.) is desired, spray affected areas with a solution consisting of a 4 to 1 mixture of potable water (80%) and B & B 3100 (20%). Allow to sit 10 minutes and rinse thoroughly.		
8.	Dry engine with pressurized air regulated to approximately 50 psig.		
9.	Remove electrical connectors where water was sprayed and dry with pressurized air regulated at approximately 50 psig. As an alternate method, use O-E-760, Type 3 alcohol or Freon TF degreaser (2002 spray aerosol for electronics) to clean and dry electrical connectors.		

Table 4 Service After Chemical Ingestion

CHEMICAL EXTINGUISHER	VACUUM	FREEDOM PF MOVEMENT CHECK	INTERNAL WASH	FIELD VISUAL/ BORESCOPE INSPECTION	DEPOT VISUAL TEARDOWN INSPECTION		COMMENTS
1. GASEOUS AGENTS							
A. CO_2							
B. N_2				•			
C. SF_6			•	•	•	•	
2. VAPORIZING LIQUIDS							REF. T.O. 1-1-1 PAGE 5-57
A. HALON 1301				•			
B. HALON 1211			•	•	•	•	
C. HALON 1011			•		•	•	
D. HALON 14			•		•	•	
E. HALON 104			•		•	•	
F. HALON 131			•		•	•	
G. HALON 1001			•		•	•	
H. HALON 1201			•		•	•	
I. HALON 1202			•		•	•	
J. HALON 2312			•		•	•	
K. HALON 2402			•		•	•	
3. FOAM							REF. T.O. 1-1-1 PAGE 5-69
A. AFFF		•	•		•	•	
B. PROTEIN		•	•		•	•	
C. SODA-ACID		•	•		•	•	
D. WATER		•	•		•	•	
E. WATER -GLYCOL		•	•		•	•	
F. TMB (TRIMETH-OXYBOROXINE)		•	•		•	•	
4. DRY CHEMICAL							REF. T.O. 1-1-1 PAGE 5-72
A. SODIUM BI-CARB.	•	•	•		•		
B. POTASSIUM BICARB.	•	•	•		•		
C. PURPLE K	•	•	•		•		
D. AMMONIUM PHOSPHATE (ABC)		•	•		•		
E. METL-X (SODIUM CHLORIDE)		•	•		•		
F. PYRENE G-1 POWDER	•	•	•		•		
G. M-1 POWDER	•	•	•		•		
H. METAL FYR POWDER	•	•	•		•		
I. DOW 230 FLUX	•	•	•		•		

JN131X1 (44X2)

Table 5. Definitions

Term	Definition
Vacuum	If dry fire extinguisher chemicals were used, vacuuming of loose debris should be performed as soon as possible to avoid imbalance or interference of moving parts due to residual deposits.
Freedom of movement check	If foam or dry fire extinguisher chemicals were used, an imbalance or interference between moving parts may result due to residual deposits. Perform freedom of movement checks.
Internal wash	Internal water wash with B&B 3100 to remove undesirable deposits. Refer to procedure and equipment list in table 2.
Field visual/ borescope inspection	This requires a complete borescope inspection (in the field) of parts suspected to have been contacted by chemical fire extinguisher; use appropriate work package inspection limits.
Depot corrosion inspection	Return engine to depot to determine corrosion damage due to chemicals ingested into engine.
Depot visual teardown	This shall be performed along with depot corrosion inspection. Check all parts suspected to have been contacted by chemical fire extinguisher; use appropriate work package inspection limits. Make certain parts are thoroughly cleaned prior to inspection.

WORK PACKAGE

TECHNICAL PROCEDURES

DEEC PRESSURE SENSING SYSTEM ANALYSIS

EFFECTIVITY: ENGINE MODEL F100-PW-229

LIST OF EFFECTIVE WP PAGES

Total Number of Pages in this WP is 14

REFERENCE MATERIAL REQUIRED

Title	Number
Engine Test	T.O. 2J-F100-11-2
Engine Troubleshooting - General	WP 501 00
Monitoring Engine Parameters (Real-Time Read) Using CEDS	WP 653 00
Engine Analyzer Unit - Operational Instructions (This unit is designated as a jet engine analyzer unit in referenced technical manual.)	T.O. 33D4-6-684-1

APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS

None

CONSUMABLE MATERIALS

Nomenclature	Specification/Vendor Part Number
Oil, lubricant	MIL-L-7808

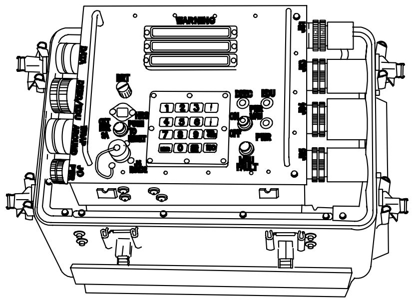
EXPENDABLE ITEMS

None

APPLICABLE SUPPORT EQUIPMENT

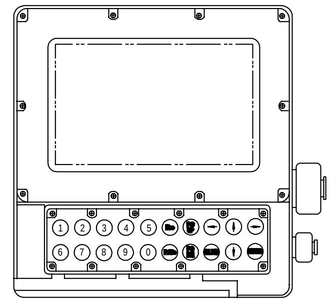
Paragraph	Function - Tool Nomenclature	Tool Number
4	Ps2 Tubing Integrity Check Vacuum Tester	PWA 57796
5	Pt6 Tubing Integrity Check Vacuum Tester	PWA 57796 or LM PWA 57371
6	Ps2 Dynamic Check Transfer Unit	PWA 56102
	Engine Analyzer Unit (EAU)	PWA 56084

ILLUSTRATED SUPPORT EQUIPMENT



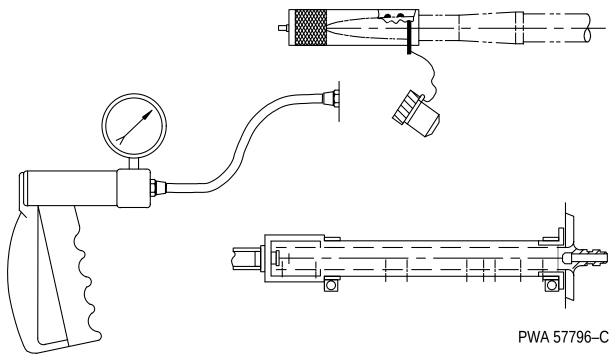
PWA 56084 –C

Figure T1. PWA 56084 Engine Analyzer Unit



PWA 56102 –C

Figure T2. PWA 56102 Transfer Unit



PWA 57796–C

Figure T3. PWA 57796 Vacuum Tester

1. INTRODUCTION.

a. This work package contains troubleshooting procedures for evaluating the DEEC pressure sensing system.

2. PRESSURE SENSE LINE INSPECTION.

(See Figures 1 through 3.)

a. Inspect Ps2, Pb, and Pt6 sense lines for loose fittings and damage. (See figures 1 through 3.)

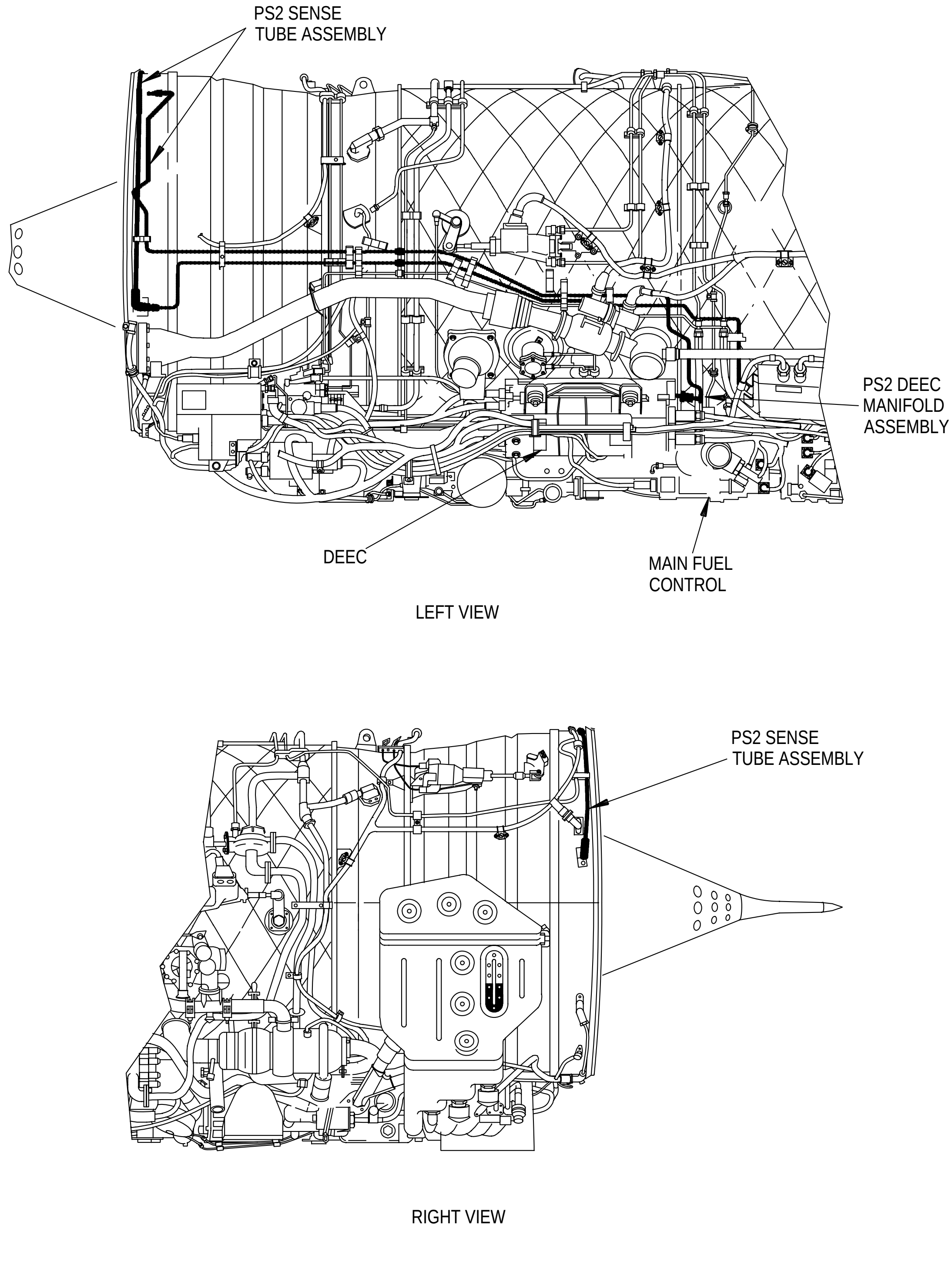


Figure 1.   DEEC Ps2 Sense Line Inspection

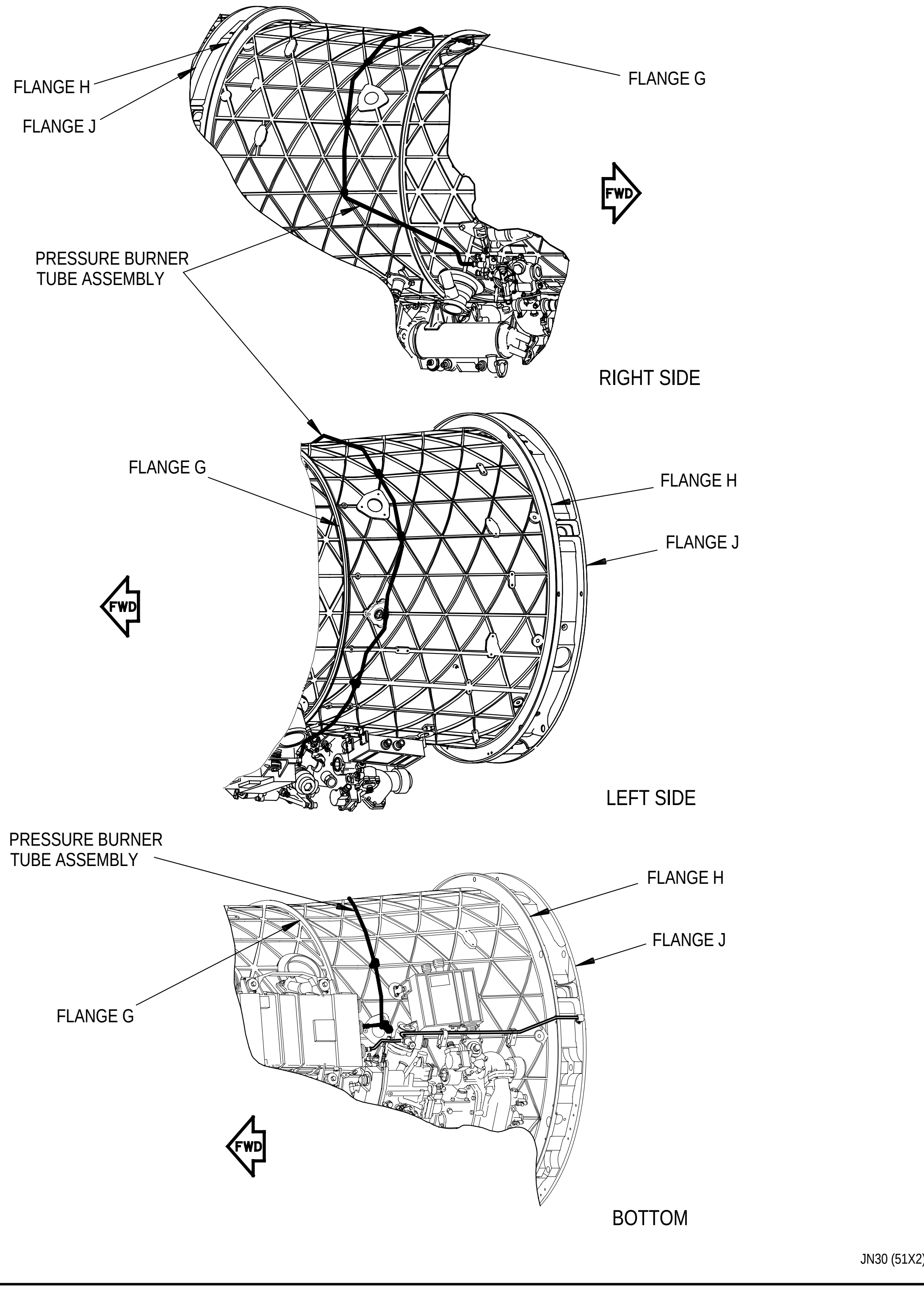


Figure 2. DEEC Pb Sense Line Inspection

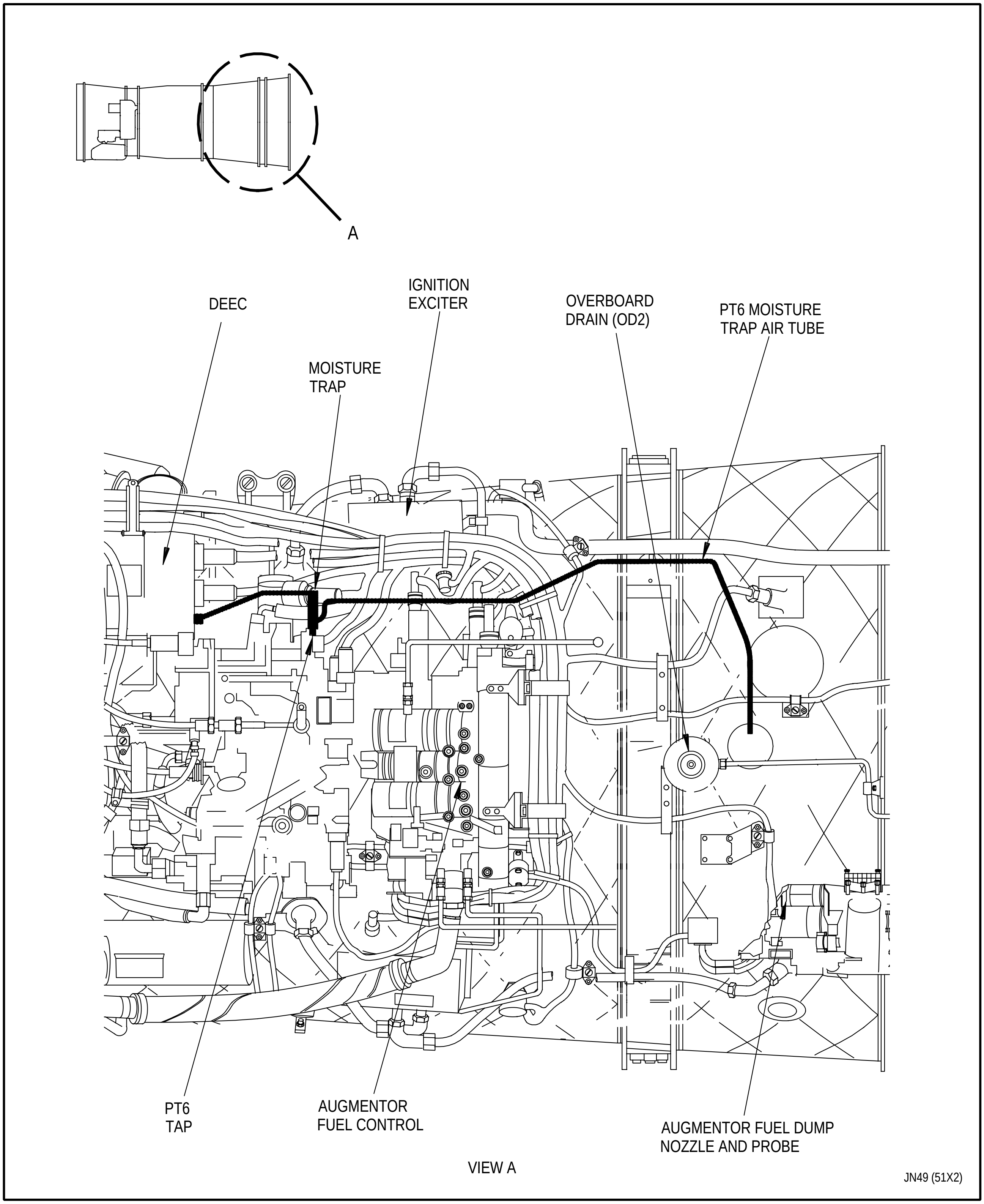


Figure 3. DEEC Pt6 Sense Line Inspection

3. DELETED.

4. Ps2 TUBING INTEGRITY CHECK.

a. Connect PWA 57796 Ps2 adapter to vacuum pump.

b. Remove Ps2 adapter cap before tool usage.

c. Connect PWA 57796 vacuum tester to Ps2 probe. See figure 4.

d. Perform vacuum check per table 1.

e. Remove vacuum pump from probe.

Table 1. Ps2 Tubing Integrity Check

CAUTION

- Do not apply pressure to Ps2 system. Damage may occur.
- Do not use liquids to check Ps2 system for leaks. DEEC transducer may be damaged.

Step	Procedure	Result	Corrective Action
1.	Evacuate Ps2 system, using hand vacuum pump until gage reads 8-16 in. Hg or 4-8 PSIA Monitor pump gage for 60 seconds.	a. No leaks present.	a. Go to step 2.
		b. Leaks present.	b. Repair Ps2 leaks in the following areas and repeat step 1 until problem is corrected.

Table 1. Ps2 Tubing Integrity Check (continued)

Step	Procedure	Result	Corrective Action
1.	(continued)		•Preformed packing in PWA 57796 Ps2 adapter • External plumbing • PS2 probe • Inlet fan case Go to step 2.
2.	Remove Ps2 line from DEEC. Apply vacuum to Ps2 system using hand vacuum pump.	a. Gage reads ambient pressure.	a. Reconnect DEEC Ps2 line. Repeat step 1 to verify no leaks, then go to paragraph 5.
		b. Gage reads less than ambient pressure.	b. Ps2 system is blocked. Determine source of blockage in hardware listed below and repair as required until problem is resolved. • External plumbing • PS2 probe • Inlet fan case

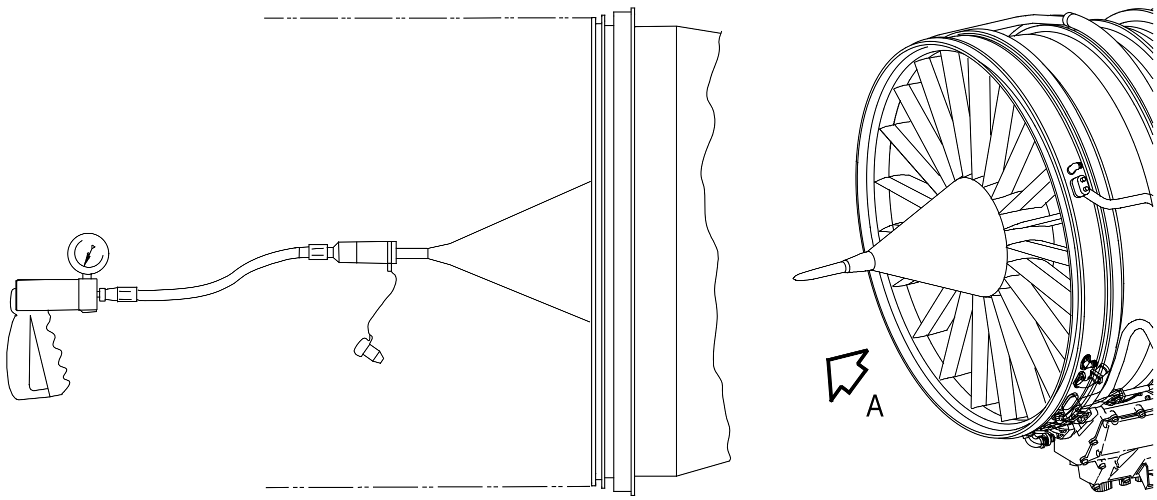


Figure 4. Ps2 Tubing Integrity Check

5. Pt6 Tubing INTEGRITY CHECK.
(See Table 2.)

a. Connect PWA 57796 Pt6 adapter to vacuum pump.

CAUTION

To prevent engine damage, do not place cap in engine inlet.

b. Remove Pt6 adapter cap before tool usage.

WARNING

To avoid injuring hands on adjacent hardware, working gloves are recommended for installing PWA 57796 Pt6 adapter.

c. Carefully slide PWA 57796 vacuum tester on installed Pt6 probe. Lubricate Pt6 probe with MIL-L-7808 lubricant as required.

d. Perform vacuum check per table 2.

e. Remove vacuum pump from probe.

Table 2. Pt6 Tubing Integrity Check

Step	Procedure	Result	Corrective Action
	CAUTION • Do not apply pressure to Pt6 system. Damage may occur. • Do not use liquids to check Pt6 system for leaks. DEEC transducer may be damaged.		
1.	Evacuate Pt6 system, using hand vacuum pump until gage reads 8-16 in. Hg or 4-8 PSIA Monitor pump gage for 60 seconds.	a. No leaks present.	a. Go to step 2.
		b. Leaks present.	b. Repair leaks in the following areas and repeat step 1 until problem is corrected. • Preformed packing in PWA 57796 Pt6 adapter • External plumbing • Pt6 probe
2.	Remove Pt6 line from DEEC. Apply vacuum to Pt6 system using hand vacuum pump.	a. Gage reads ambient pressure.	a. Reconnect DEEC Pt6 line. Repeat step 1 to verify no leaks, then go to paragraph 6.
		b. Gage reads less than ambient pressure.	b. Pt6 system is blocked. Determine source of blockage in hardware listed below and repair as required until problem is resolved. • External plumbing • Pt6 probe

6. Ps2 DYNAMIC CHECK. (See Table 3.)

a. Ps2D is obtained from bellmouth Ps2.

b. Perform dynamic check per table 3.

c. If no problems noted, return engine to service.

Table 3. Ps2 Dynamic Test

Step	Procedure	Result	Corrective Action
1.	Check test stand calibration. Compare ambient (engine off) Ps2D to Pamb.	a. Readings within limits.	a. Go to step 2.
	Ps2D vs.Pamb	± 0.2 in Hg (0.1 psia)	
		b. Readings out of limit.	b. Recalibrate test stand instrumentation.
2.	Check DEEC reading, using CEDS or EAU. Compare ambient Ps2, Pb Pamb.	a. Readings within limits.	a. Go to step 3.
	Pt2 vs.Pamb	± 0.2 in Hg (0.1 psia)	
		b. Readings out of limits.	b. Replace DEEC for pressure transducer malfunctions.

Table 3. Ps2 Dynamic Test (continued)

Step	Procedure	Result	Corrective Action
3.	a. Run engine at Idle using CEDS or EAU. b. Accelerate to Intermediate (MIL) power and stabilize for two minutes. c. Compare CEDS or EAU.values to test stand values. Ps2D vs.DEEC Ps2 d. Shut down engine.	c.1. Values within limits. 0.0 to 0.4 in Hg (0 to 0.2 psia) c.2. Values out of limits.	c.1. Go to step 4. c.2. Check lines for leaks. If no leaks found, replace DEEC for pressure transducer malfunction.
4.	Remove instrumentation from engine.		